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THEORETICAL MECHANICS IN ENGINEERING SCHOOLS

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As indicated by the title, it is proposed to deal with theoretical mechanics chiefly from the engineer's point of view, but in modern engineering colleges it is impossible to draw a sharply defined line between the education of engineers and physicists. The modern engineers of advanced scientific standing, notably research engineers of all professions, are required to be physicists as well as engineers. Moreover, a high-grade technical school seems to afford the best environment for the education of physicists, while physics forms one of the most important disciplines in the education of engineers. We shall therefore on several occasions refer to the requirements of the physicists.

Mechanics is commonly subdivided into two parts, theoretical and applied, but it is proposed here to deal in particular with the former, which bears a close relationship to mathematics and, in its widest sense, forms the main body of what is usually called applied mathematics. Often the two parts of mechanics, the theoretical and the applied, are dealt with and taught together, but it will be here attempted to distinguish rather sharply between them, although it is not always easy to do so.

The name applied mechanics is misleading and confusing. As commonly understood this science deals only with the application of theoretical mechanics to structural and mechanical engineering, but it might with equal right be said to deal with other branches of engineering where theoretical mechanics in the modern and wider sense is applied to the same extent. We shall not, however, try to widen the meaning of the term applied mechanics beyond common usage, but rather extract that which does not belong to it, for as taught at present it comprises much of an abstract nature which properly belongs under theo-

retical mechanics. The name technical mechanics (technische Mechanik) would seem better than applied mechanics, being more readily distinguished from theoretical mechanics.

We divide the science of theoretical mechanics into four sections in accordance with the nature of the bodies with which it deals: (1) Mechanics of a particle and of rigid bodies; (2) mechanics of elastic bodies; (3) mechanics of fluids, and (4) mechanics of gases. In the following we shall refer to these sections by their numbers.

Under each heading we consider separately equilibrium and motion, and the latter falls into two parts according as we consider motion with or without regard to the forces which produce it. We have thus a further subdivision into three parts: (a) Statics; (b) kinematics, and (c) kinetics or dynamics.

In accordance with this definition we include under theoretical mechanics the following subjects:

Statics, kinematics and kinetics of a particle and of rigid bodies; theory of elasticity; elastostatics and elastokinetics; plasticity; hydrostatics, hydrodynamics and aerodynamics.

Vector analysis and calculus of variation in their application to mechanics may properly be added to this list, but the abstract theory of these sciences should be taught under pure mathematics.

The list is necessarily somewhat arbitrary, but it gives an idea of the range of subjects, some of which are indeed difficult to distinguish from the applied sciences to which they form the stepping-stones.

For the sake of clearness we shall mention some of the subjects which are here considered to be outside of the province of theoretical mechanics: theory of structures, hydraulics, dynamics of gases, thermodynamics, acoustics, ballistics, capillarity, etc.

Theoretical mechanics is the foundation of all physical sciences and forms the intermediate link between pure mathematics and the various engineering sciences as well as physics. It is like pure mathematics a fundamental subject in engineering schools; it should be treated as such, and the instruction should proceed along the same lines. First a foundation of the elementary parts of the subject should be given to all students as soon as they have the necessary mathematical preparation, preferably in the freshman year. In the later years the more advanced parts should be taught, each profession being allotted what is necessary for its special purpose, without, however, disrupting the continuity and harmony in the instruction of the science as a whole.

In American engineering or scientific schools theoretical mechanics is rarely taught separately as such, at least, not in a complete manner; in fact, in many cases it does not appear on the schedule at all except in the form of special courses adjusted to the various engineering professions.

Under the heading of physics there is given in many schools a course called mechanics with the specific aim of preparing students for the study of physics. It comprises the most elementary parts of theoretical mechanics, but is not always well suited as a foundation for other subjects, for which purpose it is not directly intended. It is often repeated in a somewhat different and more extended form in the lectures on applied mechanics, being here designed to cover the elementary parts of sections (1) and (2).

In theory of structures, which is in fact a branch of applied mechanics, parts of section (1) are apt to be given. The same is true of certain subjects under electrical engineering. Under hydraulics is given a course in hydrostatics and flow of water.

Advanced parts of theoretical mechanics are often taught not only under the heading of mechanical engineering and of mathematics, but also and perhaps chiefly in physics (higher dynamics, hydrodynamics and elasticity) and in electrical engineering (mechanical forces due to magnetic fields, theory of vibrations, sound waves). Fragments of this science are also taught in the departments of civil engineering (the fundamentals of statically indeterminate structures, plasticity in connection with soil mechanics), in aeronautical engineering (hydrodynamics and aerodynamics) and in naval architecture (wave motion).

This description may not fit all engineering schools in this country but is believed to be fairly representative. On the whole it appears that in the United States theoretical mechanics is too often taught in a scattered way and as a subsidiary science, of which each department gives only what is required for its specific needs without much regard to unification of the science.

The subject is rarely given under its own name and then only in parts. In many cases no special teachers are assigned to it in such a way that they can devote all their energy to it. No one is responsible for imparting to the students a well-rounded course in theoretical mechanics giving a complete presentation of the subject within the limits set by the requirements of the various technological courses.

It is clearly impossible to do justice to a science under these circumstances. Overlappings and gaps in the instruction unavoidably occur, insufficient emphasis is placed on fundamental concepts, and what perhaps is worse, the science suffers in standing and prestige. This must react unfavorably upon the attitude of the students, who can not be expected to realize the importance of a subject the name of which

they have perhaps never heard and which is presented to them as an incidental, a handmaid to other sciences.

Turning now to European schools, it appears that ordinarily theoretical mechanics is ranked as equivalent to mathematics in importance and is regarded as one of the corner-stones of engineering education, although certain parts of (1) and (2) may be given under applied mechanics or under mathematics in some schools. Also parts of (3) and (4) are in many cases taught as belonging to the applied sciences. Yet greater portions of this science and especially sections (1) and (2) are quite commonly listed as separate and independent subjects, certainly more so than is ordinarily the case in this country. This is indicated by the names commonly given to the subject. In England it is taught under the names of applied mathematics, theoretical mechanics, analytical mechanics or simply mechanics; in France under the names of mathématique appliquée, mécanique analytique or mécanique rationelle. In Germany it is called angewandte Mathematik, rationelle Mechanik or Mechanik. In the "Handbuch der Physik,"[1] which is a monumental work of twenty-four volumes, theoretical mechanics is shown in its true perspective. The entire subject, as defined above, is here given in volumes V, VI and VII, preceded by a résumé of pure mathematics in Volume III and followed by the works on physics proper.

The remark is often heard that graduates from European technical colleges who continue their studies in this country are better equipped to attack technical problems mathematically than are American students of equal standing. Since many of those European students come over on scholarships, they are probably picked men so that it is difficult to judge whether that statement is true in general, but if it is, it is believed to be due not to superior mental capacity of the European students or to inferior ability of our teachers, but chiefly to the more complete and systematic training which European students get in theoretical mechanics.

The reason why theoretical mechanics has been given such a subordinate position in American engineering schools is not clear, but probably it is due largely to the rapid development of these schools, which have been working under a great pressure from the industry and often under economic difficulties. The demand for results, for turning out young engineers as quickly as possible, has forced the pace.

But conditions are changing, technical colleges do not have to fight so hard for their existence, and moreover, in recent years a great development has taken place in theoretical mechanics, which has acquired greater importance than ever before. We need only refer to the advances made in theory of elasticity and plasticity, in hydrodynamics and aerodynamics and the application of theoretical mechanics to electrical engineering, thermodynamics, acoustics and all branches of theoretical physics. In this connection we may mention some of the names of the many eminent workers in this field: Love, Lamb, Appell, Schrödinger, Heisenberg, Prandtl, von Mises, von Kármán, Levi Civita, Nádaj and Timoshenko.

It is time that theoretical mechanics be given its appropriate place in the curriculum of American engineering schools. As a means of training in scientific methods of thinking and as a mental discipline introductory to research work, the subject is probably unequaled.

One of the foremost German mathematicians, Dr. von Mises, in an introductory article to the *Zeitschrift für angewandte Mathematik und Mechanik* on the occasion of its first issue, made the following statement concerning theoretical mechanics:

> More than any other science it forms an indispensable foundation for creative engineering. Mechanics, which by Leonardo da Vinci was called the paradise of the mathematician, has become for the modern engineer the most comprehensive field of work, the laborious exploitation of which is left almost entirely in his hands, and from which he will reap ample rewards, even although only through hard work.

If properly taught, a course in theoretical mechanics will have great cultural value. A brief historical review of the development of this science should be given, its function as an indispensable tool for progress in all physical sciences and its profound influence on our fundamental scientific concepts should be explained.

Theoretical mechanics should be unified, harmonized and treated, not as a subsidiary, but as a science in its own right and as a fundamental in engineering education, ranking with pure mathematics and physics. It should be listed under its own name, have its own staff of teachers, preferably organized in a special independent department, and should be taught as a separate subject. Laboratories should be available for the department and the teachers should be allowed time for research.

Great as are the achievements of American engineers, it is believed that they will be still greater with such an important improvement in their training. Modern technical development calls for more refined methods of construction and hence more advanced analytical knowledge and more research. Engineers now, more than ever before, are confronted with entirely new problems. They are required to do things that have never been done before, whether in

[1] H. Geiger and Karl Scheel, 1926–29.

magnitude or in kind, and in such cases, when previous experience fails, they are thrown back on experiments and theoretical analysis, where a thorough knowledge of theoretical mechanics is indispensable.

A reform in the engineering schools as here suggested will undoubtedly meet with many obstacles. Administrative arrangements may be somewhat dislocated, text-books may have to be revised, new teachers may have to be engaged and instruction may suffer somewhat in the period of transition, but the course in theoretical mechanics may not need to be longer or more difficult than at present. What is proposed is chiefly a rearrangement of courses, with an addition of such matter as will make the resulting courses, each of them, more self-contained and complete. By avoiding repetitions time will be saved, and by a more complete and logical presentation of the subject, including a full explanation of fundamental concepts, it is believed that it will be easier for the students to grasp. The reform may perhaps be best carried out by an evolutionary process beginning with the establishment of a small department in theoretical mechanics. This department might gradually take over the scattered courses now given under various departments and strengthen them by a process of unification and completion. Thus the department would gradually grow in magnitude and importance. This method may be preferred in particular where the services of a teacher eminent in this science are available, to whom the task of building up the new department can be entrusted.

When fully developed, such a department should have charge of the entire range of subjects specified under sections (1) to (4) above, but besides the classical mechanics it might also properly include wave mechanics and mechanics of relativity. It should work in close cooperation with the department of mathematics on one side and with the various professional courses including physics on the other side.

With the adoption of such a program in the American technical colleges, it should be possible not only to equal but to surpass the achievements of corresponding European institutions.

PLANT QUARANTINE

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THE idea of quarantine[1] had its inception in connection with the attempts on the part of early Europeans to exclude and prevent the spread of dreaded plague or black death. Venice inaugurated such a restrictive measure as early as 1348, which was followed by other European countries. In spite of the long experience of human health quarantine, England did not establish her first health quarantine until 1710, and delayed in passing the Public Health Act until 1896. Thus we see that many years have been required to perfect the present highly efficient and valuable public health measures now maintained by all the progressive nations of the world, and accepted by all their citizens. It is my firm belief that plant quarantine will, in a much shorter space of time, attain a similar place in the affairs of civilized peoples. Fundamentally it is as sound to protect the plant life of a country from the constant encroachments of insect depredators and plant diseases as it is to protect human health. An abundant and available food supply is as essential to human beings as is health and almost as personal, because it affects the livelihood of every individual, since the prices and availability of food are largely regulated by supply.

In view of the fact that there is so much general misunderstanding regarding plant quarantine, this article is written with the aim of presenting the claims of this young member of the administrative family.

In the first place, quarantine is a police power. This makes it very objectionable to certain minds. Anything that questions the free rights of individuals to act as they please is ever open to criticism. Law enforcement is always a difficult task, and even the most thoroughly qualified, tactful and resourceful official has great difficulty in handling the public as agreeably as is expected. Nearly all the complaints that arise from quarantine originate in regulatory and law-enforcement proceedings. This fact must be recognized at the outset. In this respect quarantine is no different from other measures enforced by due processes of law.

Plant quarantine, like health quarantine, was born of necessity—it was not the child of speculative philosophy, nor was it an ethical experiment. The early introduction into this country of such serious pests as the codling moth, San José scale, citrus scale insects, cotton boll weevil, pear psylla, cabbage worm, gipsy and brown-tail moths and many stored-product

[1] The term *quarantine*, literally meaning a period of forty days, was originally designated as the time during which a ship, suspected of being infected with a serious contagious disease, was obliged to refrain from all intercourse with the shore. It has always come under the powers of the police.

and household pests, as well as the rapid dissemination over the land of such native insects as the bean-weevil, chinch bug, Colorado potato beetle, and other pests, were at first looked upon as a matter of course. But when it was learned that our system of agriculture, embodying the production of large areas of single crops, afforded unusually favorable conditions for these pests to propagate and do unheard-of damage, a new idea of insect immigration and migration was conceived on the proposition that exclusion is easier than extermination and cheaper than control!

With this idea in mind, the first state plant quarantine laws were promulgated and put into execution. The problem appeared easy at first, when there was but little knowledge of world economic entomology, when insect pests were supposed to be largely carried on nursery stock and when domestic and international commerce was slow and concentrated at the larger inland cities and at a comparatively few seaports. As a matter of fact, it was not difficult to enforce the laws as conditions existed then. But commerce developed faster than plant quarantine, which is well illustrated by the fact that a national conception of plant protection did not crystallize until 1912 with the passage of the first National Horticultural Law. This tardiness of action on the part of the government permitted the free entrance into most parts of the country of many insects which seriously tax the agricultural welfare of the nation.

To prevent a continuance of this unwarranted spread of pests, plant quarantine has been thoroughly overhauled and strengthened. A number of important steps were recognized and taken. It was clear that to be effective such legislation should at least provide:

1. For the absolute exclusion of certain serious pests and all articles of commerce likely to carry them from known areas of infestation. This is virtually an embargo.

2. The right to destroy, reject or exclude materials when inspections reveal the presence of insect pests or plant diseases.

3. The right to prescribe restrictions and regulations under which plant materials may be admitted into a region.

4. The power to formulate plans and enforce regulations to confine an insect to a given area and to resist its spread from one district to another.

5. The authority, power and financial means necessary to discover and to exterminate, if possible, a pest newly established in an area.

This is a difficult and complex program which requires expert training, skill and experience. Insects and diseases are carried in many ways. When all these are learned some of the complexities will be removed. Years of careful study will be required to solve many of the problems of pest introduction and to perfect ways and means adequate to meet them.

It is impossible to predict what an insect will do in a new environment. A great many of our worst pests were either unknown or of no economic importance in their native homes. Therefore plant quarantine can never be safely administered as a compromise measure.

In considering the above five points it would appear that complete exclusion is the most important, and at the same time most difficult to enforce. Such exclusive quarantines have been maintained against all products likely to carry pests from various districts throughout the world known to be infested with fruit flies, citrus canker, and the foot and mouth disease of live stock. Plant pests and diseases, as well as human diseases, such as plague, typhus and dysentery, do slip through such quarantine lines, but these failures are shallow arguments that such preventive measures are valueless and should be abandoned. As a result of such regulations the public becomes aware of the danger and the majority of those engaged in commerce or travel will cooperate to enforce the law, thus materially reducing the hazards of unknowingly bringing dangerous pests and diseases into the state or nation. Many of them will also actually assist in law enforcement. In this manner an insect pest may be kept out indefinitely or its entrance greatly delayed. Such delays enable the entomologists to study the insect and devise methods of control. There is every reason to believe that plant quarantine enforcement, together with wide and continued publicity in the form of suitable literature placed in the hands of travelers, have been responsible for the fact that the Mediterranean fruit fly has not already been introduced in sufficient numbers into California from Hawaii to have become established here. The exclusion of the Mexican orange maggot and the cotton boll weevil are other instances which might be cited in this connection. If the insect finally slips through some leak it is more likely to be apprehended than in the days before quarantines were known, and the chances of exterminating it before it becomes widely distributed are very favorable—laws, trained men, improved methods of control, equipment, like a well-trained and equipped army, are immediately available. In the case of health quarantine, plague occasionally enters our seaports in spite of the eternal vigilance of health authorities. Following this introduction an extermination campaign, at whatever cost, eventually conquers it, and no one questions the expense. And now and then a disease, like influenza, slips through the ports and sweeps over the whole country. Does any one wish to abolish health quarantine because of such lapses?

In the early history of plant quarantine, inspection was the sole basis of admission or rejection of plant materials and is still an important part of present-day procedure, particularly in dealing with intersectional, intercounty, and interstate movements of agricultural products. Inspection can never be 100 per cent. efficient because of the human limitations of the men doing the work. Yet it is the only means whereby produce can be moved with a degree of safety without paralyzing commerce. That very many serious pests are intercepted in this way is another indication that quarantine measures reduce the number of foci of infestation and thus delay a rapid spread over the entire country. Inspectors become more proficient and experienced from year to year, and it is to be expected that the service will thus be gradually improved.

The right to prescribe restrictions and regulations governing the admission of certain products results in no great inconvenience to the shipper and sets up safeguards for the protection of large districts against certain serious pests. Such safeguards in the form of restrictions and regulations are usually agreed upon before legal steps are taken, and all the cases I know of are carried out harmoniously and greatly to the benefit of all concerned. They furnish real financial incentives for those in infested areas to reduce the offending pests to the lowest possible minimum in order to secure more favorable regulations, or, as in some cases, to cause them to be entirely withdrawn.

Circumscribing certain areas within a given part of the country which may be infested with a serious pest or disease is an important prerogative of quarantine. This method is commonly employed and is at the present time in force against the gipsy and brown-tail moths, Japanese beetle, European corn borer, date palm scales, Mediterranean fruit fly, citrus canker and similar insects and plant diseases. The idea is to prevent the artificial spread of such pests throughout the country by defining boundaries across which articles of commerce most likely to carry the pest can not proceed. In the meantime everything is done through the employment of artificial and biological methods of control to reduce the infestation and thereby reduce the natural spread, which can not be stopped by legal processes of law. In this manner it is much more difficult for any of these pests to jump across the continent with plant products or other materials sent by mail, express or freight, or carried in private automobiles. As illustrations we might cite the cases of the gipsy and brown-tail moths, the Japanese beetle and the alfalfa weevil. All are gradually and slowly enlarging their boundaries, but none of them have been able to make long-range establishments throughout the country. During the period of restriction all the more important facts concerning the life habits and control of all these pests have been ascertained and distributed throughout the country for the free use of all the people in meeting any like emergencies elsewhere. In these modern times the chances of distributing pests by means of automobiles and even aeroplanes offer probably the greatest hazards now faced by quarantine officials and thoroughly justify the entirely inadequate inspection stations found at some state and national boundary lines. When the private individual is aware of the importance of this service, the necessity for it will be greatly reduced and the inconvenience caused accepted without undue criticism.

The extermination of a serious pest, once thoroughly and permanently established in a new district, is a question of very great importance, not only to the industries involved at the present time, but also to untold generations to come. It has often been argued that when once thoroughly established an insect pest can not be eradicated. This fallacious statement has been based upon a few half-hearted and inadequately and tardily financed attempts which were doomed to failure at the beginning. Eradication is possible if we as a county, state or nation are willing to pay the price. In this connection it might be well to call attention to the fact that quarantine officials in California have already discovered initial infestations of several newly introduced pests, including the pecan leaf case bearer, the rough strawberry weevil and the citrus white fly, and have apparently successfully eradicated them at a cost so surprisingly low as to call forth no criticisms whatsoever. It now looks as though the campaign against citrus canker is also a case in point. The present campaign against the newly established Mediterranean fruit fly in Florida promises to furnish a glorious example of man's ability actually to exterminate a serious insect pest established over a large territory. Only the obstructionists can prevent its final consummation.

Imagine if you can an area comprising some 1,500,000 acres of fruit trees stretching across nine states with a total valuation of approximately $1,800,000,000 and an annual crop worth $240,000,000. This is the area and investment that is subject to possible injury and financial embarrassment by the Mediterranean fruit fly. No one will deny the right of the owners of these orchards to demand protection from the invasion of any insect pest which will add to the great expense already necessary to produce, harvest and market such a valuable crop. The comparatively small sum of $4,250,000 was appropriated to safeguard this great industry, which in reality

belongs to the nation as a whole. It has been spent as wisely as possible in an intensely important and feverish campaign conducted in a few months. The situation has been under orderly and complete control throughout the undertaking. The job has not been completed. No one acquainted with the problem expected it to be finished short of at least two cropping seasons. More money is needed to finish the task. Instead of an adequate appropriation to continue this work, $1,000,000 only has been made available. If this amount is not sufficient then other funds must be obtained, because this is one case where the actual financial considerations involved thoroughly justify the expenditure of large sums. This is a national problem and should be met as such. To embarrass financially or to ruin the fruit growers of Florida to accomplish the end in view not only is unjust, but might also result in the defeat of the project. Without the whole-hearted and sympathetic cooperation of these orchardists we can not hope to destroy the very last fly.

Plant quarantine truly seeks to protect the agricultural resources for all the people. I refer to agriculture because the farmers more than any other class of people have been imposed upon by these foreign insect foes. They have been compelled to suffer great financial losses and to fight a continual and expensive campaign against insect pests and plant diseases. There is no discrimination on the part of the pest; every crop in every section of the continent is subject to their unrelenting attacks which result in absolute waste and therefore loss to the well-being of the entire country.

Is it any wonder then that the farmers have been positive in their demands for protection against additional hordes of insect pests? And even though many of the latter have already invaded the fields and orchards, are we not justified in our requests to close up the leaks and keep the others out? Plant quarantine can do this with proper legislation, judicious law enforcement, adequate financial support and the sympathetic cooperation of a well-informed public. It can never be absolute, but it can be made to meet the agricultural needs of this country through capable and determined supervision.

Are we as a people to stand aside and watch the continued procession of destructive pests file into our country, sweep over our fields, orchards and forests, destroy our live stock and invade our very homes on the shallow assumption that we are helpless because of certain uncontrollable biological factors? Or shall we challenge their right to such free aggressions by the enactment and enforcement of adequate plant quarantine measures?

OBITUARY

RECENT DEATHS

DR. J. R. GUTHRIE, dean emeritus of the medical school of the University of Iowa, died on March 14, at the age of seventy-two years.

HENRY R. HOWLAND, formerly president of the American Association of Museums and for sixty years member of the board of managers of the Buffalo Society of Natural Sciences, died at Buffalo on February 4, at the age of eighty-five years.

DANA JACKSON LEFFINGWELL, for the past three and one half years assistant professor of zoology and curator of the Charles R. Conner Museum of the State College of Washington, died on March 7 at the age of twenty-nine years. A correspondent writes: "Dr. Leffingwell was educated at Cornell University, from which institution he received the doctorate in philosophy in 1926. His greatest interest was in the field of ornithology, particularly the study of game birds, although this interest was extended to all branches of natural history. He was a keen student of wild life and of conservation. For the past three summers he had been employed by the New York State Conservation Commission engaged in making a survey of the food resources of the streams of the state."

PROFESSOR AUGUSTINE HENRY, forestry expert and botanist, died in Dublin on March 23, at the age of seventy-two years. He had been professor of forestry in University College, Dublin, since 1926. During eighteen years' residence in China, as an official of the Chinese Imperial Maritime Customs, he became interested in botany, later becoming an authority in this field.

DR. KENNEDY JOSEPH PREVITÉ ORTON, F.R.S., professor of chemistry in the University College of North Wales, died on March 16, in his fifty-eighth year.

PROFESSOR GIOVANNI MINGAZZINI, director of the psychiatric clinic of the University of Rome, died suddenly at the age of seventy years. He was the author of numerous publications on anatomical and physiological subjects and on the pathology of the nervous system.

MEMORIALS

A MEMORIAL meeting in honor of the late Dr. Richard Mills Pearce, Jr., will be held on April 15 at 4 P. M. at the Rockefeller Institute for Medical Re-

search. The speakers will be Mr. George E. Vincent, president of the Rockefeller Foundation, 1916–1929; Dr. David L. Edsall, dean of the Harvard University Medical School; Dr. Howard T. Karsner, professor of pathology at Western Reserve University, and Dr. Simon Flexner, director of the Rockefeller Institute.

THE Senate has adopted a resolution authorizing the erection of a monument costing $50,000 in Washington to Major-General William Crawford Gorgas, formerly surgeon-general of the army, in honor of his work on yellow fever at Havana, the Panama Canal Zone and Guayaquil, Ecuador.

A PORTRAIT of the late Professor Rolla C. Carpenter, of Cornell University, painted by Professor Olaf Brauner at the instance of a group of alumni headed by Eugene C. Sickles, has been accepted by the trustees and hung in the office of the Sibley School of Mechanical Engineering.

A HARVEY MEMORIAL FUND is being raised by English physicians as a token of respect for the demonstrator of the circulation of the blood and the founder of modern physiology. Americans who desire to contribute may do so by sending a check made out to the fund to Dr. Arnold W. Stott, 58 Harley Street, W.I., London. It is planned to erect a tower on Hempstead Church, where William Harvey is buried.

SCIENTIFIC EVENTS

THE CENTENARY OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

WHEN the British Association for the Advancement of Science holds its centenary meeting in London next year it is practically assured that the presidential address will be given by General Smuts. The council of the association has resolved to nominate the South African statesman as president for 1931, and General Smuts has accepted the nomination, which in the ordinary way will be submitted to the general committee.

The British Association, since its foundation in 1831, has never held its annual meeting in London. The first meeting was held at York, which was chosen as being "the most central city in the three kingdoms." Consideration was given to the possibility of returning to York for the centenary gathering, but in view of an expectation that this meeting will be unusually large there was doubt if the necessary accommodation could be found in the Yorkshire city, and the general committee decided unanimously at the Glasgow meeting in 1928 that it would be suitable and appropriate to hold the centenary meeting in London, the center of the Empire.

It is interesting to note in connection with the matter of hotels and other facilities for housing members of the association, that in 1831 Sir David Brewster wrote to John Phillips, the secretary of the Yorkshire Philosophical Society, asking him to ascertain "if York will furnish the accommodations for so large a meeting, which might perhaps consist of above 100 individuals." The hospitality apparently proved to be satisfactory, as later meetings were held at York in 1844, 1881 and 1906. It is likely, however, that several thousands of members will attend in London.

If General Smuts becomes the president of the London meeting he will be the first president elected from one of the great Dominions of the Empire. British statesmen have on several occasions held the position. The first president was Viscount Milton, M.P. for Yorkshire, and a supporter of Parliamentary reform and free trade. The third Marquess of Lansdowne presided at Bristol in 1836; the Duke of Northumberland was president in 1838; the Marquess of Salisbury between two periods of office as prime minister presided at Oxford in 1894, and at the Cambridge meeting in 1904 the late Lord Balfour was the president. The Prince of Wales gave the presidential address at Oxford in 1926. General Smuts took a prominent part in the South African meetings of the association last year and expounded at Cape Town his theory of "Holism."

The British Association this year will meet at Bristol under the presidency of Dr. F. O. Bower, Regius professor of botany in the University of Glasgow.

[1] From the London *Times*.

REFORESTATION IN NEW YORK STATE

ACCORDING to the New York *Times* the state's project for spending $20,000,000 in the next fifteen years to plant new forests on abandoned farm lands won almost unanimous approval at a public hearing on March 12 on the proposed constitutional amendment sponsored by the State Reforestation Commission.

The only opposition came from the Association for the Protection of the Adirondacks, in a letter signed by John G. Agar, its president, and filed with the Senate Judiciary Committee, before which the hearing was held.

The objections set forth in Mr. Agar's letter were as follows:

1. Because the proposed constitutional amendment, sponsored by Senator Hewitt, of Cayuga, called for a definite amount to be expended annually over a period of years, and this might cause embarrassment to the state treasury.

2. Because the prohibition against lumbering or inter-

ference with the wild condition of the state's forest lands outside of the Adirondack and Catskill Parks should not be removed.

3. Because the policy embodied in the Hewitt bill called for the expenditure of money for reforestation purposes exclusively in territory outside the forest preserve.

4. Because the proposed amendment omitted any provision that lands now owned or to be acquired by the state for forest preserve purposes should forever remain "wild forest lands." Mr. Agar thought that this omission might be construed as evidence that the state had changed its policy regarding such holdings.

To meet this latter objection, which was viewed by members of the State Reforestation Commission in attendance at the meeting as the most vital objection advanced by Agar, the commission authorized an amendment, which was presented to the committee. This amendment excluded all the language in that section to which Mr. Agar had objected and substituted the following:

> The lands of the state, now owned or hereafter to be acquired, constituting the forest preserve, as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed.

Regarding the objection having to do with the possible lifting of the prohibition against lumbering in forest preserves outside Adirondack and Catskill Parks, former Senator Lusk, counsel for the commission, said the commission had no intention of countenancing any relaxation of present prohibitions, even though in the opinion of many experts this would be in line with the most advanced policy of forestation pursued by European nations.

The question of whether the present policy of the state with regard to its forest lands should not be superseded by one permitting restricted lumbering was raised by George A. Lawyer, of Watertown, managing director of the State Development Association.

Mr. Lawyer urged that the Hewitt amendment be so changed as to open the way for restricted lumbering, at least outside the state parks. This would leave the 5,177 square miles within the "blue line" unmolested.

Other speakers at the hearing were Professor George F. Warren, of Cornell University; Professor Nelson C. Brown, of Syracuse University; Professor A. B. Recknagel, representing the Empire State Forest Products Association; Frank P. Myers, of New York, of the Society of American Foresters; J. R. Simmons, of the New York State Forestry Association; Thomas F. Luther, of Saratoga; Conservation Commissioner Alexander MacDonald, and William G. Howard, superintendent of lands and forests in charge of reforestation.

THE PEARL-OYSTER RESOURCES OF THE HAWAIIAN ISLANDS

AT the request of the commissioner of fisheries, the Navy Department on January 15 assigned the U. S. S. *Whippoorwill* to assist the Bureau of Fisheries in a hydrobiological survey of Pearl and Hermes Reef, Hawaii, from July 15 to September 1. Dr. P. S. Galtsoff, who will be in charge of the expedition, is engaged in assembling equipment and completing the plans for a four-month investigation.

In the spring of 1928, a colony of pearl oysters was discovered by fishermen in the lagoon of Pearl and Hermes Reef, some 1,200 miles northwest of Honolulu. Although the discovery was kept a secret for some time, several concerns engaged in active fishing of the pearl shells which yield the mother-of-pearl of commerce as well as valuable jewels. With no reliable information as to the extent of the pearl-oyster beds, concern was felt for their destruction before regulatory measures could be devised. The governor of Hawaii requested the Bureau of Fisheries to conduct a survey to determine the extent of the beds and what measures should be taken to perpetuate them or to increase production by artificial means. Failing to secure a special appropriation from Congress for that purpose, the territorial legislature at its last session appropriated a fund for defraying the expenses of an investigation by bureau employees. With the action of the Navy Department in providing a ship for the purpose, a preliminary survey is now made possible.

Because of the remoteness of Pearl and Hermes Reef and the impracticability of maintaining close patrol of this section of the Hawaiian Archipelago, the plan has been proposed of developing a pearl fishery in other localities and for cultivating pearl oysters somewhere on the island of Oahu, or on other islands of the eastern group. Since pearl-oyster beds formerly existed at Pearl Harbor, near Honolulu, the plan seems feasible provided a supply of oysters can be brought from known beds in Pearl and Hermes lagoon for stocking purposes. This plan requires a preliminary hydrobiological survey of local waters and an arrangement for the establishment of oyster farms in selected localities under the supervision of territorial authorities. Dr. Galtsoff plans to carry out this local survey in June and during the first half of July, with the cooperation of the territorial board of commissioners, and to complete the survey of Pearl and Hermes Reef and intervening atolls and lagoons before the stormy season begins in September.

THE FIELD COLUMBIAN MUSEUM

THE annual report of the director of Field Museum of Natural History for 1929, a 265-page volume illustrated with twenty photogravure plates, has been published by Field Museum Press. The book contains a review of the manifold activities of the institution both at home and by its many expeditions abroad, as presented before the museum's board of trustees by Stephen C. Simms, the director.

Among large gifts received by the museum during the year are $165,567 from Marshall Field, of New York; $110,079 from Stanley Field, president of the museum; $20,000 from Frederick H. Rawson; $50,000 from the late Mrs. Julius Rosenwald; a bequest of $50,000 from the late Chauncey Keep; $15,000 from the Rockefeller Foundation; an anonymous contribution of $12,500; $10,000 from Samuel Insull; $5,000 from Silas H. Strawn; a bequest of $5,000 provided by the late Katherine L. Andrin, and various sums from William J. Chalmers, Mrs. James Nelson Raymond, Richard T. Crane, Jr., the American Friends of China and Martin G. Schwab.

The museum's operating deficit for the year was $108,274.

Mr. Simms shows that the museum received 1,168,430 visitors during 1929, exceeding the records of all previous years. This was the third successive year in which attendance was more than one million. 1,363 new names were added to the museum's membership rolls during the year, bringing the total number of members contributing to the institution's support to 5,781.

The two units of the museum devoted to work among school children carried on large scale activities during 1929. More than 250,000 children were reached by the motion pictures, lectures and other educational programs provided by the James Nelson and Anna Louise Raymond Public School and Children's Lecture Division. Some 500,000 children received supplementary instruction throughout the school year by more than 1,100 traveling exhibits circulated among the schools and other centers by the N. W. Harris Public School Extension Department. Illustrated lectures on science and travel for adults provided by the museum were attended by 33,583 persons.

The report contains detailed accounts of the work of seventeen expeditions which the museum had in operation in many far parts of the world during 1929. Outstanding among these were the William V. Kelley-Roosevelt Expedition to Eastern Asia led by Colonel Theodore Roosevelt and Kermit Roosevelt; the Cornelius Crane Pacific Expedition sponsored and led by Cornelius Crane; the Frederick H. Rawson-Field Museum Ethnological Expedition to West Africa; the Chancellor-Stuart-Field Museum Expedition to the South Pacific; the Marshall Field Botanical Expedition to the Amazon; the Field Museum-Oxford University Joint Expedition to Mesopotamia, which completed its seventh season of excavations on the site of the ancient Sumerian city of Kish; the Field Museum-Williamson Undersea Expedition to the Bahamas; the Harold White-John Coats Abyssinian Expedition; the Thorne-Graves-Field Museum Arctic Expedition, and the second Marshall Field Archeological Expedition to British Honduras.

Many new exhibits—anthropological, botanical, geological and zoological—were installed during the year. One of special importance, because there is nothing else like it in any museum of the world, is a life-size restoration of a Neanderthal family and the cave they lived in some 50,000 years ago. The group is a gift from Ernest R. Graham, and was made by Frederick H. Blaschke, sculptor. During the year an extensive program of reinstallations and improvements of exhibition halls was carried on.

Many gifts of rare and valuable material for addition to the collections were received, among the donors being Colonel A. A. Sprague, Richard T. Crane, Jr., William J. Chalmers, Lord Astor, Mrs. John Alden Carpenter, Frederick H. Rawson, Mrs. Joseph W. Work, Julian Armstrong, Earle H. Reynolds, Dr. I. W. Drummond, Dr. W. J. Cameron, Homer E. Sargent, Former Judge George Bedford, Mr. and Mrs. William Bower, Franklin Bower, Henry J. Gebauer and Herbert J. Devine.

THE TUCSON MEETING OF THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION

THE annual meeting of the Southwestern Division of the American Association will be held at Tucson, Arizona, from April 21 to 25. It will be the fifth joint meeting of the Southwestern and Pacific Divisions. The program will be arranged in three sections: the biological sciences, the physical sciences, and the social sciences.

On Monday, April 21, there will be a luncheon symposium on "Solar and Terrestrial Relations Including Heliotherapy," to be arranged by Dr. Allen K. Krause, director of the Desert Sanatorium and Research Institute; Dr. A. E. Douglass, director of the Steward Observatory, University of Arizona, and Dr. R. J. Leonard, of the department of geology of the University of Arizona. The afternoon will be devoted to section meetings. The second John Wesley Powell Lecture will be given in the evening by Dr. Rodney Howard True, head of the department of botany and director of the Botanic Garden of the University of Pennsylvania.

On Tuesday, April 22, section meetings will be held both morning and afternoon. A luncheon symposium considering "Desert Life" will be arranged by Dr. H. L. Shantz, president of the University of Arizona. The program for the evening meeting has not yet been announced.

On Wednesday, April 23, section meetings will be held in the morning and afternoon. Dr. Byron Cummings, director of the Arizona State Museum, University of Arizona, will have charge of a luncheon symposium for a discussion of the economic welfare of scientific men. The annual banquet will be held in the evening, at which time Dr. Francis Ramaley, head of the department of biology of the University of Colorado, will deliver the retiring president's address.

The installation of Dr. H. L. Shantz as the president of the University of Arizona will take place on Thursday, April 24. In the morning there will be a symposium on "Opportunities and Responsibilities of the University of Arizona," when addresses will be given on "The University and Natural Resources," by Dr. George Otis Smith, of the U. S. Geological Survey; "Beauty in American Life," by Lorado Taft, and "The Unity of Nature as Illustrated by the Grand Canyon," by Dr. John C. Merriam, president of the Carnegie Institution. The installation ceremonies will take place in the afternoon, when Dr. Shantz will deliver his inaugural address.

On April 25, field trips will be arranged to points of scientific interest in the vicinity of Tucson, and on Saturday, April 26, there will be held a conference on "Forest, Wild Life and Range Problems."

Interesting and instructive exhibits of technical apparatus will be made by scientific instrument companies. In addition, special preparations are being made for exhibits illustrative of the art of the desert and its archeological resources, as well as some noteworthy features of its plant and animal life.

The Ecological Society of America will have a special program at the Tucson meeting, and several ecological field trips are being planned.

One fare and a half will be in effect under the certificate plan, providing that one hundred and fifty tickets are purchased for the meeting. It is expected that there will be at least this many in attendance. The Santa Rita Hotel has been designated as headquarters. Hotel reservations should be made as early as possible.

SCIENTIFIC NOTES AND NEWS

DR. KARL T. COMPTON, professor of physics in Princeton University, will be installed as eleventh president of the Massachusetts Institute of Technology on the afternoon of June 6. Following the inauguration ceremony, Dr. Samuel W. Stratton, for the past eight years president of the institute, now to be chairman of the executive committee of the corporation, will hold a reception with members of the corporation for Dr. Compton at the president's house. Dr. Stratton and Dr. Compton will speak at the reunion banquet of more than 2,000 alumni on the evening of June 7. Sir William H. Bragg, of the Royal Institution of Great Britain, will be the commencement orator at the graduation exercises on June 10.

A LUNCHEON was given in Washington on March 27 by Mrs. James C. Pilling in honor of the eighty-sixth birthday of Major-General A. W. Greely. The other "ranking guest" was Brigadier-General David L. Brainard, who was one of the twenty-five men accompanying the Greely Arctic Expedition in 1881.

DEAN MORTIMER E. COOLEY, past president of the American Engineering Council, was presented with the Washington Award for 1930 in Chicago on February 24, "for vision and constructive leadership in the education of the engineer." The principal address was by Dr. Howard McClenahan, secretary of the Franklin Institute, and greetings were extended from the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The presentation of the award was made by Mr. William S. Monroe, president of the Western Society of Engineers.

DR. HUGO ECKENER received the gold medal of the National Geographic Society on March 27. The inscription on the medal reads: "This special medal of the National Geographic Society is awarded to Hugo Eckener for his work in furthering the progress of airships and to commemorate the first around-the-world flight of the *Graf Zeppelin* in 1929 under his command."

ACCORDING to the *Christian Science Monitor* a wood named in honor of Albert Einstein has been inaugurated in the Jewish Colony of Dilb near Jerusalem. The Jewish National Fund is planting a forest beginning with 10,000 trees. Eight trees ceremoniously planted include one on behalf of the National Fund, the Jewish Agency, the German Reich, the Hebrew University, the Jewish Community in Palestine and the Agricultural Group, which will look after the planting.

DR. ALEXANDER WETMORE, assistant secretary of

the Smithsonian Institution, has been elected an honorary member of the Deutsche ornithologische Gesellschaft, and a foreign member of the British Ornithologists' Union.

DR. FRANK C. BAKER, of the University of Illinois, was recently elected a corresponding member of the Zoological Society of London.

DR. JEAN CHARCOT has been elected a member of the Paris Academy of Sciences in the section of *membres libres* for those who have rendered service to the art of medicine.

AT the annual general meeting of the British Institute of Chemistry, Dr. G. C. Clayton was elected president in succession to Professor Arthur Smithells. The Meldola Medal was awarded to Dr. R. A. Morton, of Liverpool, and the Sir Edward Frankland Medal and Prize to Mr. B. W. Bradford.

ROYAL MEDALS of the Royal Geographical Society have been awarded as follows: Founder's Medal to Mr. F. Kingdon Ward, for his geographical explorations and work on botanical distribution in southwest China and southeast Tibet. Patron's Medal to Mr. C. E. Borchgrevink, for his pioneer Antarctic Expedition of 1898 to 1900, which was the first to winter in the Antarctic, to travel on the Ross Barrier and to obtain proof of its recession. The council has made the following awards: Victoria Medal to M. Emmanuel de Margerie, for his distinguished contributions to the science of land forms; Murchison Grant to Colonel H. Wood, R.E., for his surveys with the Tibet Mission and the De Filippi Expedition to Central Asia; Back Grant to Mrs. Gordon-Gallien, for her expedition to the Kalambo Falls; Cuthbert Peek Grant to Mr. Owen Lattimore, for his travels in Mongolia and Chinese Turkestan, and the Gill Memorial to Lieutenant-Colonel Reginald Schomberg, D.S.O., for his explorations in the Tarim Basin and the Tien-Shan.

DR. EDGAR ALLEN, who has been professor of anatomy in the University of Missouri since 1923, has been appointed dean of the faculty of medicine and director of the university hospitals at the University of Missouri. Dr. Allen succeeds Dean Guy L. Noyes, who died on February 4. Dr. Noyes had been a member of the faculty of medicine since 1902 and dean since 1917.

DR. J. J. WEIGLE, associate professor of physics at the University of Pittsburgh, has been appointed, effective October, 1930, professor of physics and director of the laboratory at the University of Geneva, Switzerland.

W. B. BOLLEN, after five years' service as assistant chemist at the Idaho Agricultural Experiment Station, has been appointed assistant professor of bacteriology and associate bacteriologist at the Oregon State College and Experiment Station, Corvallis, where he has charge of teaching and research work in soil bacteriology.

DR. FREDERICK J. CULLEN, medical officer in the U. S. Department of Agriculture, has been selected to head the drug control work of the department's food, drug and insecticide administration. This appointment fills the vacancy caused by the resignation of Dr. James J. Durrett to become state health officer of Alabama.

DR. J. W. WHITAKER, senior lecturer in applied science in the department of mining, University College, Nottingham, has been appointed principal of the college. He is the author of a number of publications on mining, chemistry and physics.

PROFESSOR J. ARTHUR THOMSON will resign the chair of natural history (zoology) in the University of Aberdeen as from September 30.

ALOIS PAIKERT DE SEPROS, formerly Royal Hungarian Agricultural Commissioner, accredited to the governments at Washington and Ottawa, has been appointed the first director general of the newly organized Museum of Agriculture at Cairo, through which the palace of the late Princess Fatima has been bought for the nation.

DR. ROBERT DEC. WARD, professor of climatology at Harvard University, has been appointed a member of the International Climatological Commission.

AT the request of Dr. Waldemar Kaempffert, director of the Museum of Science and Industry, Chicago, the American Engineering Council has appointed Professor Mortimer E. Cooley, dean emeritus of the School of Engineering of the University of Michigan; Edward L. Ryerson, Chicago, Illinois, and Joseph Roe, New York City, to be its representatives on the advisory board of the museum now being planned in Chicago.

AT the invitation of the League of Nations, Dr. Remington Kellogg, chairman of the technical committee of the Council for the Conservation of Whales, under the auspices of the American Society of Mammalogists, and a member of the staff of the Smithsonian Institution, sailed for Rotterdam on March 24. The league held a session on April 3 on the subject of whaling and on practical methods of conserving the supply, and Dr. Kellogg attended in the capacity of advisory expert, representing the council. After this session Dr. Kellogg plans to visit European museums, chiefly for the purpose of studying their cetacean material.

DR. C. JUDSON HERRICK, of the University of Chicago, will spend the spring and early summer at the Effingham B. Morris Biological Farm of the Wistar Institute of Anatomy.

DR. H. H. DONALDSON, of the Wistar Institute of Anatomy, will leave early in June for Europe, where he will remain until September. He plans to be present at the Anatomical Congress in Amsterdam.

MRS. AGNES CHASE, associate botanist in the grass herbarium of the U. S. National Museum, is now collecting in Matto Grosso, Brazil. After visiting Diamantina (Minas Geraes), a historic botanical collecting ground, she went south into São Paulo and then west on the railroad across Matto Grosso to Puerto Esperanca.

PROFESSOR DOUGLAS JOHNSON, of Columbia University, recently returned from a journey of nine months largely devoted to geologic and geographic studies in the southern hemisphere and the Orient. In January and February he spent several weeks examining elevated shore platforms on portions of the Japanese, Hawaiian and California coasts. In Honolulu he addressed the Hawaiian Academy of Sciences on "Interpretations of Shore Scenery," and at Stanford University lectured before the students of the geological department on "The Origin of Certain Supposed Eustatic Shore Benches." On his way east, Professor Johnson spoke on coastal problems before the geological students of the University of Arizona, addressed a general assembly of students at the University of New Mexico and delivered two lectures at Denison University, Ohio.

PROFESSOR W. H. TWENHOFEL, of the department of geology at the University of Wisconsin, will make a lecture tour of the southwest early in April to discuss the origin and constitution of limestone in related rocks and the influence of climate and topography on sedimentation. He will speak at Wichita, April 7; Oklahoma City, April 8; Tulsa, April 9; Fort Worth, April 10, and St. Angelo, April 12, under the auspices of the geological societies of these cities.

THE annual address complimentary to the Michigan Academy of Sciences on behalf of the University of Michigan, delivered by Professor Charles P. Berkey, was entitled "With a Geologist in the Gobi Desert." This address was delivered on March 21 at the University of Michigan, where the academy was in session. On the same day Dr. Berkey gave an address on the general subject "Geological Engineering Projects." Both lectures were illustrated.

ROYAL CANADIAN INSTITUTE lectures during the past month include: Mr. Walter Granger, chief paleontologist and second-in-command, Central Asiatic Expeditions of the American Museum of Natural History, "Gobi Trails"; Professor J. Stanley Gardiner, professor of zoology and comparative anatomy, University of Cambridge, England, "Coral Reefs," and Professor Bradley Stoughton, head of the department of metallurgical engineering, Lehigh University, "Materials for Aircraft Construction."

SCIENCE SERVICE has arranged a series of radio talks to be given on Friday afternoons over the Columbia Broadcasting System. The talks will be given from 3:45 to 4:00 P. M., eastern standard time. Following is the program for April: April 4; Dr. Paul R. Heyl, physicist, U. S. Bureau of Standards, "Measuring the Earth's Attraction." April 11; Dean Edward W. Berry, professor of paleontology, Johns Hopkins University, "The Ancestry of our Trees." April 18; Dr. C. G. Abbot, secretary of the Smithsonian Institution, "The Sun and Ourselves." April 25; Dr. Arthur H. Compton, professor of physics, the University of Chicago, "What is Light?"

DR. CHARLES SINGER, lecturer in the history of medicine of the University of London, will give two courses in the department of zoology in the summer session of the University of California, from June 30 to August 9. The courses will be a historical introduction to biology and a seminar in the history of science.

THE C. J. SYMONS Memorial Lecture of the Royal Meteorological Society was delivered on March 19, by Dr. Herbert Lapworth, who spoke on "Meteorology and Water Supply."

THE sixtieth annual meeting of the Wisconsin Academy of Sciences, Arts and Letters will be held at the University of Wisconsin on April 11 and 12. Many of the discussions, which will be illustrated, will be of popular and public interest. Meeting jointly with the academy will be the Wisconsin Archeological Society and the Midwest Museums Conference. Several hundred museums in five states will be represented at the conference.

THE forty-fourth annual meeting of the Iowa Academy of Science will be held at Iowa State College on May 2 and 3, under the presidency of L. B. Spinney, head of the department of physics at Iowa State College.

THE twenty-fifth annual meeting of the American Association of Museums will be held at Buffalo from June 4 to 7. The first three days will be devoted to business, and the fourth day to visiting places of interest in the vicinity of Buffalo.

An Associated Press dispatch from Berlin on March 27 reads as follows: "Professor Albert Einstein has presented to the Prussian Academy of Sciences a new paper which he has written with Dr. W. Mayer on two strictly static solutions of the field equations of his uniform field theory, which connects gravitation and electricity. These solutions were described as follows: These field equations can be rigorously solved in two cases. The first case is that of a spherically symmetrical field in space, for example, the external field of an electrically charged sphere of fixed mass. The other case is that of the static field of any number of uncharged mass particles at rest with respect to one another."

The $6,900,000 appropriation for combating the Mediterranean fruit fly in Florida, which has passed the Senate and is now in conference, may be subjected to another drastic cut at the hands of the House members. The Senate passed the reduced amount recommended by the President only with the understanding that the House members who held hearings in Florida on the fruit fly situation should pass upon the item and reduce it still further if they thought it too large. In the meantime, the federal field inspection force in Florida has had to be reduced by 600, with the prospect of still further dismissals.

A bill introduced in Congress by Representative Griffin, of New York, would provide a medal of honor for government workers who do distinguished work along scientific lines. The bill provides that recommendations of not more than five persons each year would be made to the President by a commission representing the National Academy of Sciences, the American Association for the Advancement of Science and the American Engineering Council. This medal, to be known as the Jefferson Medal of Honor for Distinguished Work in Science, would carry with it a payment of one hundred dollars, and a further annual payment of between one and five hundred dollars.

Alpha Eta Chapter of Phi Sigma, national biological research society, was installed at the Oklahoma Agricultural and Mechanical College at Stillwater on March 13.

A chapter of the Beta Beta Beta, biological fraternity, was installed at Carthage College, Illinois, on February 27. Dr. Arthur C. Walton, professor of biology at Knox College, was the installing officer.

The Paul Herbst collection of Chilian Hymenoptera, which was purchased by a friend for the Museum of Comparative Zoology of Harvard University, has arrived in excellent condition. It is particularly rich in bees and contains a number of types.

A total sum of $5,000,000 in gifts by Julius Rosenwald, philanthropist, removes the last obstacle to the Museum of Science and Industry of Chicago. The museum will be in the reconstructed Fine Arts Building in Jackson Park. A brief was filed in answer to a suit seeking an injunction to stop the project on the ground that the South Park Commissioners violated the law in issuing $5,000,000 in bonds for the reconstruction of the building which later will be used by a private corporation. Mr. Rosenwald's original contribution of $3,000,000 was to equip the museum, the brief stated. An additional donation of between $1,500,000 and $2,000,000 is to be given by Mr. Rosenwald for construction.

The creation of the Lois Grunow Memorial Foundation, for the furtherance of medical science, has been made possible by a gift of $1,000,000 from Mr. William C. Grunow, of Chicago, in memory of his daughter. It is planned to establish a clinical laboratories at Phoenix, Arizona, where Mr. Grunow spends the summers.

The late Mrs. Elizabeth R. Stevens, of Swansea, Massachusetts, who died on February 4, bequeathed $100,000 to Harvard College.

The La Follette bill to appropriate $900,000 for the construction by the government of a forest products laboratory on land to be donated by the University of Wisconsin at Madison was passed by the Senate on March 25.

Provision for the modernization of the U. S. Naval Observatory in Washington, D. C., is made in a bill which was ordered favorably reported by the House Committee on Naval Affairs on March 25. The bill authorizes appropriations as follows: Purchase and installation of equipment, utilities and appurtenances for astrographic and research work and modernization of the astronomical plant, $160,000; construction of astrographic laboratory, $65,000; construction of a service building, $40,000; total, $265,000.

The last state legislature appropriated $335,000 to be used for the construction and equipment of a chemistry annex at the University of Illinois, and the first contracts have been awarded. The annex has been designed to house laboratories, class and storerooms for the elementary chemistry courses, as well as offices for the administrative staff of the division and members of the instructional staff. It will stand between the present chemistry building and the old agricultural building, and will be connected directly with the old agricultural building to permit remodeling of the north wing for use as a chemistry laboratory. The new building will be 200 feet long and 50 feet wide, with three floors in addition to the basement.

THE New York State Legislature has appropriated $285,000 for the erection of a laboratory building at the New York State Agricultural Experiment Station at Geneva. This building will house the divisions of horticulture and botany and will make possible the expansion of the other research divisions which will remain in the old laboratory buildings. It is expected that additional funds for equipment will be made available later.

Nature states that at the ninth annual dinner of the London section of the British Association of Chemists, held on March 1, Sir Arnold Wilson outlined a scheme which is now under consideration for a building to house the principal societies and institutions in London concerned with chemistry and chemical industry or related to them. The societies interested are the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, the Institution of Rubber Industry, the Institution of Petroleum Technologists, the Institute of Fuel, the Institute of Metals, the Iron and Steel Institution of Petroleum Technologists, the Institute ciety. It is proposed that all these societies should be housed under one roof and their libraries pooled for the common use of their members. As Sir Arnold pointed out, the scheme has the advantage that each society would retain its own individuality while giving its members facilities for informal meeting with members of related societies. It would thus be an important step towards the cooperation and coordination so necessary to-day in allied branches of science and technology. It was stated that £100,000 has already been promised in furtherance of the scheme.

DISCUSSION

OUR CONTEMPORARY RESEARCH "ACES"

CLINICAL medicine is justly proud of the four typical biologists mentioned in Dr. E. E. Free's recently published list[1] of the ten living scientists, whose removal at the present time would be "an irreparable loss" to future clinical science. Without questioning the limitations and bias that led this retired agricultural chemist to select these particular four experimenters from the scores of equally skilled contemporary scientists, whose published results are in many cases too technical for a non-clinical agriculturist to understand, one can still raise the question if his selected four, or any dozen scientists similarly selected, are in reality "irreplaceable." What effect would it have on medical progress if Dr. Free's hand-picked research "aces" were to-morrow "sunk without trace" in our historical archives?

It is, of course, a picturesque hypothesis of the lay mind that medical progress is due solely to the half dozen specially gifted individuals of each generation whose initiative and exceptional mentality make them the pace-makers of clinical evolution. Conventional history is rich in such alleged research giants, varying from the mythical therapeutic demigods of ancient Greece to the almost equally apochryphal Listers, Pasteurs, Oslers and Ehrlichs of recent decades. To the lay mind, the premature removal of any one of these semi-deified medical "wizards" would have retarded clinical evolution for untold centuries.

This picturesque hypothesis of the sporadic personal factor in medical evolution is, of course, not endorsed by competent sociologists who have made a real effort to determine the underlying factor in clinical progress. One of the most convincing studies of this evolutionary mechanism is Professor Stern's recent volume,[2] "Social Factors in Medical Progress," published under the auspices of the faculty of political science, Columbia University. Professor Stern cites historical evidence that so-called gifted individuals were not important factors in our historic medical development, and frankly contends that the same progress would have been made on the removal of any or all of the ancient popularly recognized research heroes.

Professor Stern's most convincing argument that important clinical inventions and discoveries are determined solely by the general rise in cultural level in a dozen collateral fields of non-clinical science is based on the simultaneous, independent, multiple discoveries, and inventions in all fields of practical medicine. He cites hundreds of such research duplicates, ranging from the ten practically simultaneous inventions of the laryngoscope to the five independent discoveries of adrenalin.

Eight simultaneous discoveries of the cellular basis of plant and animal life. At least three independent demonstrations of artificial immunity following inoculation with attenuated cultures of anthrax bacillus. Five officially recorded demonstrations of the clinical value of cowpox vaccinations, before Court Physician Jenner hogged the limelight. Five independent discoveries of the phenomenon of heartblock. Three simultaneous demonstrations of vasco-constrictor nerves. Five independent introductions of ether as a surgical anesthetic.

The ophthalmoscope simultaneously invented in Germany and England. Agglutination of typhoid bacilli independently discovered in England and France. The cause of amebic dysentery indepen-

[1] E. E. Free, "Who Are the Greatest in Science," *North American Review*, January, 1930.

[2] B. J. Stern, "Social Factors in Medical Progress," Columbia University Press, 1927.

dently determined in Austria, Russia, Egypt, and the United States. Coexistence of cardiac hypertrophy and kidney lesions simultaneously observed in England, France and Germany. Sphygmomanometer independently invented in Italy and England, and ten years later, simultaneously improved in Germany and France. The chemical nature of respiration simultaneously worked out in Holland, Sweden, Italy, and France. The hypodermic syringe independently invented in Ireland, France and Scotland.

If Dr. Stern's thesis is correct, the premature removal of Jenner would not have retarded the development of cowpox inoculation by a single year. It merely would have shifted the focus of popular reward to Schleswig-Holstein. Pasteur's removal would not have retarded the development of applied bacteriology, but would have shifted the central figure of national propaganda to Germany. Or to England. Lister's premature death would have deified his American contemporary, Guerini, the at present unknown though no less real father of aseptic surgery, without retarding in the least the historic development of modern surgical technique.

Popular reward of medical research plays some queer tricks with historic medical perspective. Richet, semi-deified with the Nobel prize for his duplication of Rosenau and Anderson's rediscovery of what was at the time referred to in European laboratories as the "Theobald Smith phenomenon," for which, ten years earlier, Theobald Smith had claimed no priority, since he knew that the same phenomenon had been fully described as early as 1838 by physiologists whose names are at present unknown to the newspaper public. Banting, honored for his confirmation and popularization of the work of a Chicago physiologist, at present unknown to reportorial fame, who ten years previously[3] had prepared and tested insulin, for which work this physiologist claimed no personal credit, knowing that it was but a logical application of the pioneer researches of a half dozen unexploited Allens and Opies. d'Herelle glorified for his picturesque nomenclature ("bacteriophage") with which he confirmed and popularized the well-known transmissible bacterial lysin of Twort. Widal immortalized in the "Widal reaction" for his service in popularizing Gruber's confirmation of Gruenbaum's discovery of a reliable diagnostic test for typhoid fever.

All honor to Dr. Free's hand-picked research "aces." Long may they wave. And equal honor to the scores of unexploited contemporary medical scientists, whose publications are too technical for Dr. Free's non-clinical appreciation. But clinical medicine may well congratulate itself that it is not dependent upon these alleged sporadic geniuses, but upon the more real though less picturesque cultural urge of ten thousand collateral scientists, an evolutionary force dwarfing the allegorical research demigods of conventional history.

W. H. MANWARING

STANFORD UNIVERSITY

[3] *J. A. M. A.*, 1923, *81*, 1303.

σ

RECENT discussion in SCIENCE seems to make it quite clear that mμ, and not μμ, is the proper symbol for the millimicron, that the micron, μ, is properly conceived as a micrometer, and that the small Greek letter in general stands for the millionth part of the standard unit.[1] Thus I am informed that γ is used for the microgram and λ for the microliter.[2] This standardized usage raises an interesting question about the proper symbol for the millisecond (0.001 sec.). Psychologists and physiologists, at least, use σ for the millisecond.

This use of σ for the millisecond was explicitly introduced by Cattell in 1885 on the mistaken analogy that a thousandth of a second should have a symbol analogous to μ, which he then thought of (as have so many others since) as meaning a thousandth of a millimeter rather than a millionth of a meter.[3] Wundt adopted the symbol σ at once, giving it the weight of his authority at the time when reaction-times, expressed in milliseconds, were a very important topic in psychology.[4] I do not know how or when physiologists came to adopt the symbol.

Recently the matter has been complicated further by the necessity of psychologists for dealing with the microsecond in work on the localization of sound. Here the original error has been multiplied by the use of σσ for the microsecond.[5]

There is no simple solution of the difficulty. The usual symbol for the second is "sec.," but there is some authority for using "s." Logically then one might write ms. (not σ) for the millisecond, and σ (not σσ) for the microsecond.

A very different ambiguity arises because σ has come to be used in statistical work for the standard deviation. So far as I can discover, this use of the

[1] See the clarifying note by N. E. Dorsey, SCIENCE, n.s., 71, 1930, 67f., and the earlier discussion there cited.

[2] By Dr. G. K. Burgess, of the Bureau of Standards, and by Dr. Dorsey, who cites numerous references.

[3] J. McK. Cattell, *Philos. Stud.*, 3, 1885, 102: "My proposal that $\sigma = 0.001$" is made on the analogy to the commonly used symbol $\mu = 0.001$ mm." *Cf.* also, Cattell, *ibid.*, 3, 1886, 306.

[4] W. Wundt, "Physiologische Psychologie," 1887, II, 267.

[5] E. M. von Hornbostel and M. Wertheimer, *Sitzungsber. d. preuss. Akad. d. Wiss.*, 1920, 338. I must plead guilty to having been one of those who have helped in publication to establish this faulty symbol.

symbol was initiated by Pearson in 1894.[6] It was not used by Galton or Edgeworth. Ordinarily no confusion arises from the double meaning, but sometimes, as when the standard deviations of reaction-times are under consideration, there may be very real difficulty. Cattell seems to have antedated Pearson by nine years, but of course Wundt's and Galton's schools did fuse until comparatively recently.

There is no proposal for reform that I wish to make, unless it be that the word *millisecond* might be used more and the symbol σ less. I can not help wondering what others think about this matter.

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PEDOGRAPHY

IT is obvious that the students of soil science are not agreed on the term they will use for their division of natural science. There has been a trend toward the word *pedology*, but in some circles there is a protest because the term is now being used by a limited section of the medical profession.[1] It has been pointed out that *paedology* or *paidology* is the word which should be used by the medical profession.[2] The pronunciation of the two will be essentially the same, but this need not cause confusion. Furthermore, Brown[3] has pointed out that pedology was first used by the Russian soil scientists in 1865.

The term pedology has been presented to a larger audience than the students of soil science by the publication of Wolfanger's little book called, "The Major Soil Divisions of the United States."[4] He uses not only pedology, but several other words having the same root. These terms are: pedologist, pedologic, pedological, pedalfer, pedalferic, pedocal and pedocalic. The subtitle of his book is "A Pedologic-Geographic Survey." Since he has placed considerable emphasis upon the distribution of the soils, it is suggested that *pedography* be added to the list, and that the term shall have as its connotation the geographic aspects of soil science. How simple the title of Wolfanger's book would have been as "The Pedography of the United States"!

Geographers are frequently on the receiving end of jibes from the followers of the so-called pure or natural sciences, who imply that they are not contributors but borrowers. Whether or not this criticism is justifiable I will not debate, but assuming that there is a borrowing, it becomes imperative that the students of soils come to some agreement as to what they will call their division of science, for the geographers will borrow, and the success of the borrowing depends in a large measure upon the progress of pedology. In defense of the borrowers it is necessary to insist that the material selected should have some habitat significance. The student of modern geography is not qualified to undertake a regional analysis unless he has a rather systematic knowledge of the physical environment, and certainly soil is an important element in most parts of the world. Huntington and Carlson's "Environmental Basis of Social Geography"[5] is one of the first text-books of geography to treat soils according to the attributive system.

Geographers are generally agreed that climate is the most important element of the physical environment. The science of climatology is an important part of the training of a geographer if he is to understand the environment. The geographical distribution of climates or climatic types is of major importance, and here and there in the literature of geography and climatology appears the term *climatography* which connotes regional or geographical climatology.

If climatography is appropriate for that division of climatology which treats of regional climate, so pedography may be used for that division of pedology which treats the geographical distribution of soils.

The purists may insist that pedography should connote simply a description of soils, but geography is not a descriptive science simply. Just as geography, as an exact or social science, has become interpretative, so pedography may be considered as that division of soil science that treats of the regional distribution of soils. Pedology, then, may be concerned chiefly with the vertical attributes of soil types, and pedography with their distribution and delineation.

GUY-HAROLD SMITH

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OVERHEAD

RECENTLY I wrote a paper on the carpenter bees of the Philippine Islands and sent it to the Philippine Bureau of Science for publication. It was typewritten in Manila, and on November 21 Mr. R. C. McGregor sent me the typed copy for verification before printing. The package reached me on January 10 through the War Department, postmarked Washington, D. C. The letter accompanying it was endorsed as follows:

[6] K. Pearson, *Philos. Trans.*, 185A, 1894, 80. Dr. T. L. Kelley writes me that Dr. H. M. Walker also finds this place to be the first use of σ for the standard deviation.

[1] See W. A. Hamor's note in SCIENCE, 71: 70, January 17, 1930.

[2] See P. E. Brown's note in SCIENCE, 71: 243, February 28, 1930.

[3] *Ibid.*

[4] Published by John Wiley and Sons, Inc., New York, 1930.

[5] Published by Prentice-Hall, Inc., New York, 1929.

(1) November 26, Department of Agriculture and Natural Resources.

(2) November 27, Department of Agriculture and Natural Resources. Respectfully forwarded to the Secretary to the Governor-General, requesting transmittal.

(3) December 4, Office of the Governor-General of the Philippine Islands. To the Chief, Bureau of Insular Affairs, War Department, Washington, D. C.

(4) January 6, War Department, Bureau of Insular Affairs, Washington, D. C. Respectfully transmitted.

Considering all this, the package came through fairly promptly, and I do not suggest that these various offices, organized as they are, are not efficient. I do suggest, however, that all this overhead is senseless and wasteful, and foreign to the spirit which I have come to regard as characteristic of this country.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO,
JANUARY 10, 1930

QUOTATIONS

THE NEW PLANET

AT a meeting of the Royal Astronomical Society on March 14 the report from the Lowell Observatory of the discovery of a new planet was discussed.

The following summary is given in the London *Times:*

Dr. A. C. D. Crommelin, who presided at the meeting, said the occasions when a new major planet was added to the members of the solar system were exceedingly rare and very important. Apart from the "small vermin of the heavens," as the minor planets had been called, there had been only two cases of discovery of new primary bodies in the system—those of Uranus and Neptune. Thursday was the one hundred and forty-ninth anniversary of the discovery of Uranus by Sir William Herschell and that anniversary was marked in a very appropriate way by news of the discovery of another planet.

The telegram, which had been received by the society from America, through the Bureau of the International Astronomical Union at Copenhagen, was as follows (explanatory words interpolated in square brackets):

Lowell Observatory search for trans-Neptunian planet revealed an object of fifteenth magnitude, for seven weeks in rate of motion and path conforming to approximate distance [the late Professor Percival] Lowell assigned. [The position on] March 12 3h. 7 time-seconds west [of] delta Geminorum, agreeing with Lowell's longitude.—SHAPLEY.

The society's foreign secretary had prepared the following telegram, which had been approved by the council:

President, council and fellows of the Royal Astronomical Society, in meeting assembled, send the Lowell Observatory their heartiest congratulations on the great discovery of the trans-Neptunian planet.—TURNER, *foreign secretary.*

Those whose memories extended back over half a century would remember the efforts made both on theoretical and observational lines to find the trans-Neptunian. On the theoretical side a lot of time and great care had been spent in determining the position of a body that would account for the small residuals in the motion of Uranus. Neptune was not used much because it had not been observed long enough to get an exact mean orbit. Lowell thought there were two possible positions, 180° apart, either of which would account for the small residuals he found. The latter of the two, which he probably looked upon as the least likely, now proved to be the one which agreed with the present position. All observers had had great faith in Lowell's prediction, and those at his observatory had spent a long time observing the new planet without saying anything about it. They had been taking photographs along the ecliptic, showing very faint stars, and studying them for changes of position. At last, in the middle of January, they found a body moving slowly in the constellation Gemini. They followed it for seven weeks, and now they had got an orbit sufficient to show that it was outside Neptune and within Lowell's orbit.

Such a planet had been conjectured to exist by a good many people besides Lowell. The study of comet orbits had led to the conjecture of a planet with a period of about three centuries. Another telegram gave an estimate of the size of the body. It was said to be of the fifteenth magnitude and intermediate between that of the earth and Uranus. The exact mean of the two would give a diameter of 19,000 miles, but it was too small for its dimensions to be measured with any accuracy. There was a hope that images of the planet might be found on past photographs. When once the approximate orbit of this body was made out there was very good hope that on the Franklin Adams chart and on the photographs taken at Heidelberg and elsewhere when searching for minor planets this planet would be found.

Professor H. H. Turner, director of Oxford University Observatory, said it was hard that Professor Lowell should have died before verification of the discovery which he felt sure would come had been obtained. His confidence was shown in the fact that he left a legacy for the observatory which he founded to continue the search he had instigated and formulated. It was specially pleasing to find that the discovered planet came out so close to the prediction he made. The honor of the prediction must be shared to some extent with their old friend Professor W. H. Pickering, who, when he was working for Harvard in 1919, made a prediction which was very near to the place.

Dr. J. Jackson, chief assistant at the Royal Observatory, said that, at a rough calculation, the planet in seven weeks should have moved something like half a degree in its geocentric orbit. Now it should move about 30 seconds a day. It was now in the position 7 hours 15 minutes. Lowell's figures for 1914 placed it in longitude 84. That was deduced entirely from the perturbation of Uranus. On that basis its predicted position to-day

would be longitude 100; actually it had been found on longitude 107. Lowell's work was worthy of considerable attention. He thought the discovery would explain a good deal of the perturbation of the planets.

Professor A. S. Eddington, of Cambridge, remarking on the closeness of the prediction, said that if one had had faith and had given a long exposure with a reasonably large lens, the planet must have been picked up. Many of them had been much impressed with the thoroughness, caution and honest work at Lowell Observatory.

Captain Ainslie, president of the British Astronomical Association, asked if the planet had been seen or only photographed.

The chairman said that as the size was given he assumed it had been seen visually.

Professor Turner thought this might rather be a calculation from its brightness.

Dr. Jackson said they were going to make a search of the Franklin Adams plates at Greenwich, but if the planet were there it would be very near the edges of the plates.

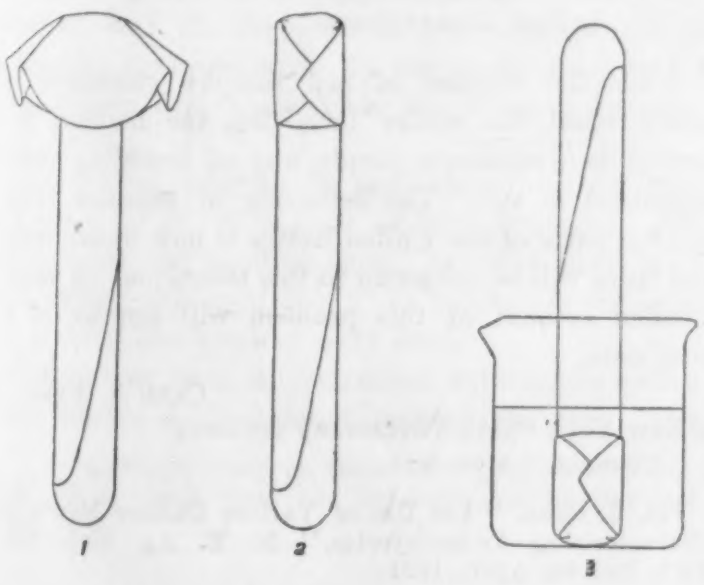
Summing up, the chairman said this planet would probably have an effect on Halley's Comet that would alter the period of each return by as much as a couple of days, so that some of the unaccounted for days in the last two returns might meet with an explanation. In the course of time, when they had got a good enough orbit, it would involve the preparing of new tables of Uranus and Neptune. In the case of Neptune, the mass was very quickly got by the discovery of a satellite; there was very little chance of discovering a satellite of this body, and the only way to get its mass would be by getting the perturbations of Uranus and Neptune, and that would only give a rough result. Finally, every book of descriptive astronomy from that day was out of date.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CONVENIENT METHOD OF REDUCING DESICCATION IN SLANT CULTURES

IT is often desirable to reduce desiccation in slant cultures of fungi or bacteria, or in tubed media. The time-honored method of sealing cultures by dipping the stoppered end of the tube in paraffin presents some unsatisfactory features. When cotton stoppers are permeated with the wax they are difficult to remove and somewhat unwieldy. When replaced they do not fit tightly, and are not then proof against contamination. When the cotton is filled with wax the exchange of gases through the stoppers may be so reduced as to limit the growth of the culture, or alter the appearance of the organism.

Folding a piece of tinfoil over the mouth of culture tubes is a convenient means of reducing desiccation and has the advantage that the tubes of culture media may be sterilized after the foil caps are in place. Since vapor may readily escape between the foil cap and outer wall of the culture tube a greater reduction in the rate of desiccation is often desirable. In this paper is described a method of reducing desiccation in slant cultures that seems to possess certain advantages.



Paper disks of a convenient size for folding over the end of culture tubes are cut from thin, tough and pliable paper. These disks are stacked up and submerged in melted paraffin just deep enough to cover them. After the papers are thoroughly saturated with the wax they are lifted out of it one at a time with needles or fine-pointed tweezers. They are held vertically for a few seconds to allow the excess of wax to drain off and are then dropped into cold water. The wax should be kept hot enough to allow the excess to drain from the paper before solidification occurs. The waxed paper disks may be used as soon as they are removed from the water or may be stored until needed.

Before a tube is sealed the open end is warmed slightly and the end of the cotton stopper is singed. A waxed paper disk is warmed until the wax becomes plastic, a condition that is obtained just before the melting-point is reached. It is then folded over the end of the tube (Fig. 1) and pressed firmly against the outer wall, and the folded edges are pressed down firmly. This procedure gives a waxed paper cap (Fig. 2) that permits an exchange of gases along the line of the folds, reduces the desiccation materially and keeps the cotton stoppers free from wax. The caps may be removed by giving them a firm twist or by unfolding the paper. When a perfect seal is desired, the tubes are inverted and dipped one or more times into paraffin, to a point just above the waxed paper cap (Fig. 3). For this purpose the tempera-

ture of the wax should be but slightly above its melting-point.

This method of reducing desiccation in slant cultures and in tubed media, as used for several years by the writer, has been uniformly successful. The method is very useful when a long period of incubation is required. Cultures can be kept in a suitable condition for study for several weeks, and, by completely sealing, sterile tubed media may be kept ready for use during a long period.

The method has a decided disadvantage. When the tubes are sealed the cotton stoppers are kept moist by water of condensation, permitting fungi to grow through them and contaminate the cultures. Contamination in this way is almost entirely avoided, however, when the work of preparing the waxed paper disks, the storing of them and the sealing of the tubes is done under aseptic conditions.

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U. S. DEPARTMENT OF AGRICULTURE

A METHOD FOR DETECTING ACID-FAST BACTERIA IN THE SOIL

IT has been assumed that saprophytic acid-fast bacteria are rather wide spread in nature and that their appearance in soil is not an uncommon occurrence. There has been, however, no definite evidence to substantiate this assumption.

In view of these facts experiments have been under way for several months attempting to identify these organisms under various natural conditions and more especially in the soil.

The technique used is as follows. Soil samples in approximately one gram portions are mixed with about 50 to 60 cc of modified Büttner's[1] medium in 200-cc flasks. This medium which has previously been sterilized in the flasks has the following composition:

Tap water	1000 cc
K_2HPO_4	0.5 gm
NH_4Cl	0.5 gm
$MgSO_4$	0.2 gm
$CaCO_3$	0.2 gm

It will be noticed that this medium contains no available carbon. To supply this carbon, paraffin-coated pebbles are placed in the flasks. These pebbles are large enough so that they will extend above the surface of the medium. Supplying carbon in this way seems to be quite effective in keeping down contamination since a great many organisms can not thrive under these conditions.

Incubation is carried out at 47.5° C. It was found that at lower temperature there were gross contaminations by molds so that the acid-fast bacteria were so completely covered as to render detection of the organism very difficult and their isolation virtually impossible. When the high temperature was used there was no evidence of contamination by molds.

Up to the present time this technique has been applied to some thirty soil samples, and acid-fast bacteria have been found in every instance after from two to seven days' incubation.

In the incubation process some of the paraffin melts from the coated pebble and forms a thin pellicle on the fluid. The organisms are found on the under side of this pellicle and on the paraffined surface of the pebble. They can also be found, in many cases, adhering to the sides of the flask just above the surface of the medium. Under this latter condition we frequently get large masses of the organism which are comparatively free from contamination. After prolonged incubation it is usually possible to detect masses of the organisms with the naked eye. These have the appearance of opaque bodies on the surface layer of paraffin, on the pebble or on the side of the flask. In chromogenic species the color can be detected in these areas.

The organisms when isolated show numerous variations both morphologically and culturally. A discussion of these variations does not seem necessary at this time. When the organisms are stained with hot carbol fuchsin all are highly resistant to decolorization by 3 per cent. HCl in 95 per cent. alcohol.

A number of these organisms have been isolated by making dilution plates using Conn's[2] medium to which is added gentian violet in a dilution of 1 to 10,000. The composition of this medium is as follows:

Water	1000 cc
Agar	15 gm
Glycerin	10 gm
K_2HPO_4	1 gm
Sodium Asparaginate	1 gm

While the number of soil samples examined is rather small, the writer feels that the method described is a relatively simple way of detecting these organisms in soil. The collecting of samples from various parts of the United States is now under way, and these will be subjected to this technique. A more detailed account of this problem will appear at a later date.

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[1] Hans Büttner, "Zur Kenntnis der Mykobakterien insbesondere ihres quantitativen Stoffwechsels auf Paraffinnährboden," *Arch. f. Hyg.*, 97: 12, 1926.

[2] H. J. Conn, "The Use of Various Culture Media in Characterizing Actinomycetes," N. Y. Ag. Exp. Sta. Tech. Bul. 83, April, 1921.

SPECIAL ARTICLES

SUSCEPTIBILITY OF WHITE MICE TO THE VIRUS OF YELLOW FEVER[1]

IT has been found that if yellow fever virus is injected into the brains of white mice, a certain number become ill and die. The virus can be propagated in mice indefinitely by the intracerebral injection into normal mice of the brain of an infected mouse. Once established in mice the passage virus invariably produces death after an intracerebral injection. In the early passages death usually took place on the seventh or eighth day. In subsequent passages there was a gradual shortening of the incubation period, so that by the sixtieth passage death occurred on the fifth day.

The virus is highly neurotropic in mice. Infection can be produced by the injection of the virus into the brain, spinal cord or eye. Other routes of injection, such as intraperitoneal, subcutaneous, etc., very seldom cause illness and death, though a considerable proportion of such mice are rendered immune to a subsequent intracerebral injection of the passage virus.

At death the virus can be demonstrated to be present in large amounts in the brain, spinal cord, peripheral nerves and the adrenal glands. The blood, liver, spleen, kidney and testis contain very little if any virus.

Continuous passage of the virus through mice leads to a gradual loss of virulence for rhesus monkeys. Monkeys were injected with the third, twenty-ninth and forty-second passages in the mice. The animal injected with the third generation died of typical yellow fever on the fifth day. The monkey which received mouse virus from the twenty-ninth generation developed a febrile reaction on the sixth and seventh days and recovered. This monkey was subsequently shown to be immune to virulent yellow fever virus derived from another monkey. The third monkey was injected with the forty-second generation of mouse virus and remained well. It was found dead on the forty-eighth day, death being due to some intercurrent disease.

The mouse virus can be preserved in 50 per cent. glycerine, at 2°–4° C., for at least fifty-eight days but not for one hundred days. Infective brain kept in a frozen condition at −8° C. retains its virulence for at least one hundred sixty days.

The mouse virus is neutralized by immune yellow fever serum derived from monkey or man. This effect can be shown by mixing infective mouse brain with the serum to be tested and injecting the mixture intracerebrally into normal mice. Normal serum has no protective action.

There are very few macroscopic changes in mice dying of an infection with yellow fever virus. Hemorrhage into the stomach, in about 50 per cent. of the mice, is the only abnormal finding sufficiently common to warrant the conclusion that it is caused by the virus.

Microscopical examination of the brain shows in the early stages a definite proliferation of the endothelium of the capillaries with an accumulation of mononuclear cells in the perivascular spaces, while in the late stages the picture is distinctly reminiscent of encephalitis lethargica. The ganglion cells undergo necrosis and there are invariably present eosinophilic nuclear changes resembling those present in the liver of man and monkey dead of yellow fever and described as inclusions by Torres[2] and Cowdry.[3]

The neurotropic character of yellow fever virus in mice and the nature of the pathological lesions produced are factors giving strong support to the theory that the infectious agent of yellow fever should be classified with the filtrable viruses.

In relation to these experiments it is of some interest to add that Dr. A. W. Sellards informs me that Dr. Laigret in the study of yellow fever patients in Senegal noted in exceptional cases minor neurological symptoms and suggested the importance of testing the central nervous system for the presence of virus and to observe the effect of inoculating the virus into the central nervous system.

A detailed account of which the above is a summary is in preparation and will be published in the near future.

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[1] The monkeys used in these experiments were supplied by a grant from the DeLamar Mobile Research Fund.

AN INTERPRETATION OF MASS CONJUGATION IN PARAMECIUM

WHEN freshly gathered material for the study of Paramecium is assembled at the spring of the year shortly after the great thaw in this latitude, it may be observed after a few days that a strong tendency to conjugation manifests itself in the wild culture. Under these conditions the presence of one hundred to

[2] C. M. Torres, Supplemento das Memorias Instituto Oswaldo Cruz, 1929, No. 6.

[3] E. V. Cowdry and S. F. Kitchen, SCIENCE, 69: 252, 1929.

upwards of three hundred couples in a single slide culture may be regarded as an indication of maximum conjugation. This has been observed in the spring of 1926 and again in the autumn of 1929, the greater number being recorded in the spring. The occurrence of so many conjugants precisely at the turning-points of the year suggested a reference to climatic conditions. The spring and autumn maxima occur at what Chatton[1] has called periods of crisis characterized by trophic disequilibrium. It is indeed enough to witness the decline of aquatic vegetation in late autumn in order to convince one of the fact that the nutritive conditions in the water are undergoing rapid change at that season, and the well-known sensitiveness of Paramecium to change of temperature points in the same direction. If a slide culture is placed for a few minutes between double windows in freezing weather, all movement ceases until they are restored to the warm room; if exposed too long to the cold, they die without encysting. No experimental means have yet been discovered to make Paramecium encyst, and it is sometimes stated positively that Paramecium never becomes encysted (Perrier).[2] Métalnikov[3] established the fact, from laboratory cultures in Russia, that the mean daily fission rate was greater in summer than in winter; and in 1915, when owing to defective heating the room temperature fell below normal, the number of annual generations dropped from about four hundred to two hundred and thirty-eight.

Treatment of laboratory cultures at room temperature with distilled water will also induce mass conjugation. We have observed this effect in the month of February, this year, both in subcultures and in renewed cultures. In watchglasses containing a small quantity of freshly matured and diluted hay infusion, seeded with a few individuals from the main culture, after two days of preliminary multiplication the addition of a few drops of distilled water brought about a large proportion of conjugants within the next twenty-four hours. H. S. Hopkins[4] found that the addition of certain salts to his renewed cultures made them more susceptible to conjugation after a preliminary period of multiplication lasting from three to five days.

[1] E. Chatton et Mme. M. Chatton, "La sexualité provoquée expérimentalement chez un Infusoire: *Glaucoma scintillans*. Prédominance des conditions du milieu dans son déterminisme," *Comp. Rend. Acad. Paris*, 176: 1091–1093, 1923.

[2] E. Perrier, "Traité de Zoologie," fasc. II, p. 503. Paris (Masson) 1897.

[3] S. Métalnikov, "Immortalité et rajeunissement dans la biologie moderne." Paris (Flammarion), 1924.

[4] H. S. Hopkins, "The Conditions for Conjugation in Diverse Races of Paramecium," *J. Exp. Zool.*, 34: 339–384, 1921.

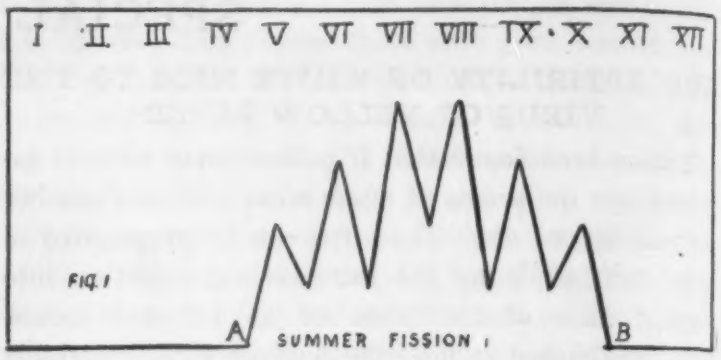

FIG. 1

From the various observations which we have made from first to last and in general accordance with the known reactions of Paramecium, we feel that there is sufficient foundation for plotting a tentative growth curve representing the annual cycle of Paramecium under natural conditions in the climate of Montreal. Experiments on Paramecium have yielded results of the highest importance since the classical researches of Maupas, but it seemed worth while to make the attempt to frame a picture of the probable course of events in the open waters, especially under a climate where the seasonal changes are sharply accentuated and consequently where such questions can best be put to the test. The point marked "A" in the chart stands for the turn of spring; the point "B" marks the autumn transition. At both these seasons, as mentioned, mass conjugation has been found to take place, suggesting a twofold significance for it: first, that of activating fission for the summer; secondly, that of stiffening resistance for the winter. The apparent simplicity of the annual cycle, commencing with the vernal conjugation, passing through the summer fission to the autumn climax and ending in the winter rest, is perhaps an argument for its probable approximation to the truth. The spring maximum may be compared with the formation of reproductive cysts in other Infusoria, and the autumn maximum is paralleled by the resting cysts.

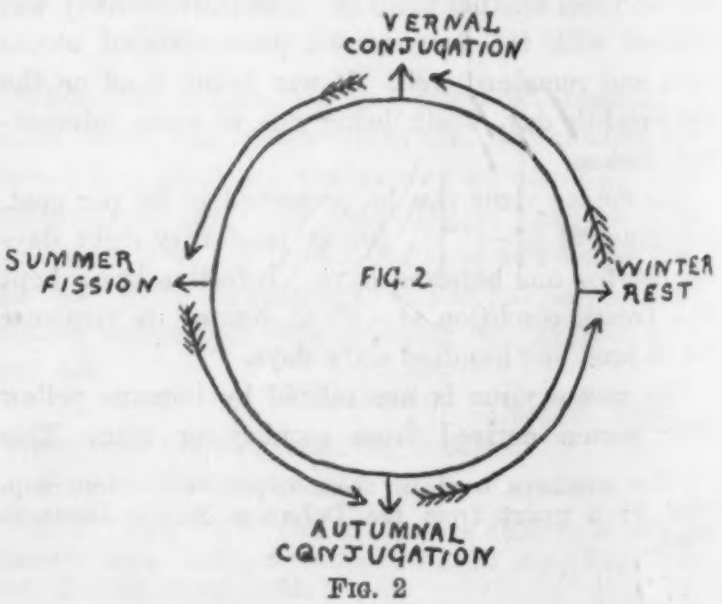

FIG. 2

A prominent feature of mass conjugation is its simultaneity, comparable in this respect with the simultaneous cleavage of embryonic cells. At the annual changes from winter to spring and from summer to autumn, the Paramecium population responds *en masse* to the exigencies of the times. The normal summer fission rate is likewise fairly uniform in its incidence, so that the multiplication of an actively feeding community is essentially a synchronous reaction of large numbers of individuals to alterations in the internal medium or endoplasm, while the so-called epidemics of conjugation are mass demonstrations following upon alterations in the external medium. Conjugation, which can be induced experimentally in a mixed culture without the addition of salts, thus appears to result from the interaction or concurrence of two sets of factors, external and internal, not one to the exclusion of the other; and under natural conditions, the seasonal changes are enough to provoke similar responses.

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IS THERE A NEUROMOTOR APPARATUS IN DIPLODINIUM ECAUDATUM?

DURING the course of recent investigations on a hitherto undescribed ciliate occurring in the cecum of cattle, the writer made comparisons with *Balantidium coli* from the pig. The centralized neuromotor apparatus described and figured by McDonald[1] in the latter protozoan could not be differentiated. In order to check the staining reactions *Diplodinium ecaudatum* was studied, because Sharp's[2] excellent description and figures give the impression that the neuromotor apparatus of the latter ciliate is easily demonstrated. According to this author a mass of material which occurs just above the base of the left skeletal area and between the left extremities of the dorsal and the adoral membranelle zones has the staining reactions of amphibian nervous tissue. Fibers run out from this body to all the motor membranelles, to the membranelles for food taking and also to the esophagus, forming a ring around the latter from which branches extend longitudinally. The reasons which are stated for assigning a neuromotor function to the above structure are: (1) Its general similarity to primitive metazoan nervous systems; (2) its position within the body, not being connected to adjacent structures; (3) its freedom from attachments and other characteristics that are required for an organelle of contraction or support, and (4) its connection by nerve-like strands to all mobile territory. The writer was greatly surprised to find the relationships of this area not as Sharp described them and therefore questions his interpretation.

METHODS OF INVESTIGATION

A method was devised of orienting Protozoa in the paraffin so that complete serial sections could be made either transversely or longitudinally through isolated individuals. This method is described in another publication (1930). One especially good series contains fifty-four cross-sections cut at three microns and another series contains forty-two longitudinal sections of the same thickness, though usually there were about twenty-five to thirty longitudinal sections. It is much easier to trace tissues and layers in series thus prepared than in sections through masses of Protozoa which have been imbedded in gelatin capsules, because the observer knows definitely the orientation of a particular organism and is not confused by adjacent sections of other individuals. The technique described by Sharp of differentiating with Mallory's triple connective tissue stain and with iron hematoxylin was followed.

POINTS OF DIFFERENCE FROM SHARP'S INTERPRETATION

On the whole, the correctness of the accurate, painstaking description by Sharp of the arrangement and anatomy of the various organelles and tissues was fully confirmed. However, there occurred in my material organisms that are very closely allied to Diplodinium which were not mentioned by Sharp and were described and figured, though very inaccurately, by S. Awerinzew and Mutafowa.[3] To include these forms the above authors founded the genus Metadinium. Other very closely allied ciliates which Crawley[4] included in the genus Epidium were not noted either by Sharp or by myself. In my studies, the layer of ectoplasm lying directly under the pellicle was not observed to be alveolar. It stained very deeply and persistently with iron hematoxylin and appeared to be of very compact material. Directly under this layer was another

[1] James Daley McDonald, "On *Balantidium coli* (Malmsten) and *Balantidium suis* (sp. nov.), with an Account of their Neuromotor Apparatus," Univ. Calif. Publications in Zool., Berkeley, v. 20 (10), May 8, pp. 243–300, figs. A-O, pls. 27–28, figs. 1–14. 1922.

[2] Robert G. Sharp, "*Diplodinium ecaudatum*, with an Account of its Neuromotor Apparatus," Univ. Calif. Publications in Zool., Berkeley, v. 13 (4), May 4, pp. 43–122, figs. A-D, pls. 3–7, figs. 1–33. 1914.

[3] S. Awerinzew and Mutafowa, "Material zur Kenntnis der Infusorien aus dem Magen der Wiederkäuer," *Arch. f. Protist.*, 33: 109, 1914.

[4] H. Crawley, "Evolution in the Ciliate Family Ophryoscolecidae," *Proc.* Acad. Nat. Sci. Phila., 75: 393, 1924.

layer which is described by Sharp as alveolar, but which in my material exhibited the same staining reactions as the inner boundary layer of the ectoplasm. This layer could be followed into the folds that comprise the various outer and inner lips and furrows at the anterior end of the body. It is also thicker here than in the posterior end of the body. In a number of places it is reflected back upon itself for considerable distances especially in the area where Sharp describes the motorium. In fact, in the thin and well-destained sections a fold of this layer resembled in size, shape and position the motorium figured by Sharp, and no other tissue could be differentiated which could be made to answer for this body. Sharp's drawings are all semidiagrammatic, made by superimposing camera lucida sketches of several sections. It is, therefore, difficult to compare them with sections on slides. From my point of view his microphotographs of hematoxylin preparations indicate that his slides were not sufficiently destained. For example, his Fig. 15, plate 6, shows in addition to the motorium another mass equally dense on the ventral side of the cytostome and still another in the dorsal membranelle zone. This author states that the inner boundary layer of the ectoplasm stains very deeply. The writer has noted repeatedly that in sections of three microns the hematoxylin stain disappears from this layer after treatment for from three to five minutes with 2 per cent. iron alum, whereas the nuclei, the pellicle with its underlying ectoplasmic layer, the myonemes and the basal granules of the cilia remain black or bluish black for nearly an hour. The mass which appears to correspond to the motorium is completely destained in all my hematoxylin preparations, though, as Sharp reported, it usually retains the acid fuchsin of Mallory's stain as does also the inner boundary layer of the ectoplasm and the micronucleus. On the basis of my interpretation the motorium is a fold of an ectoplasmic layer which forms a cylinder surrounding the esophagus and also underlies the ciliary rootlets of the membranelles because it extends into all the lips and furrows at the anterior end of the body. It is obvious that sections through this layer would appear as strands. The conditions set forth by Sharp for a coordinating nervous mechanism do not, therefore, appear to be fulfilled in the structure that the writer finds in this ciliate.

Observations concerning the Diet of *Diplodinium ecaudatum*

According to Sharp this ciliate lives solely upon bacteria, but my observations indicate that it ingests much larger food particles. Individuals taken from a steer that had been feeding on green grass appeared to have eaten some of this material. One case of cannibalism was noted. The smaller ingested ciliate was not crushed by passing through the esophagus of its captor; digestive processes had not at the time of fixation progressed sufficiently to interfere with the staining reactions. The wall of the esophagus of *Diplodinium* appears to be folded into longitudinally extending accordion-like pleats which permit marked distention. Sharp's figures indicate this folding but he makes no comment. It is difficult to conceive how the passage of the ingested ciliate through the esophagus of its captor could have occurred without breaking the esophageal ring as Sharp figures this structure.

Comment and Conclusions

My interest was directed to the observations herein reported by the fact that disruptions of certain intestinal ciliates in unfavorable environments occurred by an outflow of the endoplasm through the cytostome. The digestive systems of the Protozoa, unlike those of the Metazoa, are characterized by a break of the layers. The pellicle and ectoplasm which line the mouth and esophagus are broken through at the distal end of the latter organelle. What prevents under normal conditions the outflow of the fluid endoplasm? This question led to the development of the above-mentioned method of sectioning individual Protozoa in the same way that embryos are sectioned. It is obvious also that the presence or absence of nerve-like fibers will have a bearing on the answer to the question. The writer realizes fully the responsibility for the stand that is here maintained because Sharp's researches led the way to a number of successful investigations of neuromotor systems of various ciliates from widely separated groups.

CHAS. W. REES

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BOOKS RECEIVED

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SCIENCE NEWS

Science Service, Washington, D. C.

THE COMING TOTAL ECLIPSE OF THE SUN

THE first total eclipse of the sun in the United States since 1925 is the attraction that will bring astronomers from all over the country to positions near San Francisco on April 28. Then the tip of the moon's shadow will graze the earth along a line crossing the coast in Marin County, California, about 20 miles north of the Golden Gate, traveling northeastwards across the state, passing just south of Marysville and Honey Lake.

Crossing into Nevada about 40 miles north of Reno, the shadow continues over the southeastern corner of Oregon, over Idaho, and then leaves the earth at a point some fifty miles east of Butte, Montana. Only over this narrow line, scarce a half mile wide, will the sun be obscured, and the ordinarily invisible corona around it flash into view for a second or so.

This is a very unusual eclipse, a so-called "central" eclipse, the first of its kind in 18 years. Usually, an eclipse is either total or annular. Either is caused by the moon getting directly between the sun and earth. But the distances vary. Sometimes the shadow of the moon reaches to the earth and beyond, and the regions which it crosses see the sun totally obscured. This is a total eclipse. At other times, the shadow, conical in shape, with the point away from the sun, fails to reach the earth. Then the eclipse is "annular"; the moon, seeming a little smaller, does not fully cover the sun, and a ring of sunlight is seen around it.

A central eclipse, like the coming one, is both. Where it starts, out in the Pacific Ocean, it is annular. The earth, being round, bulges several thousand miles towards the moon, so by the time the eclipse approaches the Pacific Coast the tip of the shadow reaches the earth and the eclipse becomes total. But instead of the shadow on the earth being a hundred miles or more in diameter and causing an eclipse lasting several minutes, the shadow in April will be under a mile, and the eclipse at its longest will last a second and a half. Then, after the tip leaves earth in Montana, the path in which the ring of sun can be seen continues across Saskatchewan, Manitoba, Hudson Bay, Quebec and Labrador and ends out in the middle of the Atlantic Ocean, 5 hours, 29 minutes and 55 seconds after it began, some ten thousand miles away.

An annular eclipse is of no scientific value, but along the path of totality astronomers will try to make observations only possible at a total eclipse. At Camptonville, Yuba County, about 125 miles northeast of San Francisco, will be a party from the Lick Observatory of the University of California, under the direction of Dr. J. H. Moore. Dr. D. H. Menzel will be with him. Farther east, near Honey Lake, will be a group from the Mount Wilson Observatory, in charge of Dr. S. B. Nicholson. On the edge of the Black Rock Desert, about 12 miles northwest of Gerlach, Nevada, Dr. Heber D. Curtis, director of the Allegheny Observatory at Pittsburgh, will make observations.

Flying in airplanes above will be still other astronomers. Dr. R. J. Trumpler, of the Lick Observatory, will fly in an army airplane, while other observations will be made from planes from the Mare Island navy yard.

Because of the great number of bodies in the solar system that exert a pull of gravity on the moon, its path is a very tortuous one, and astronomers are not able to predict its path with absolute precision. As a result, says Dr. R. G. Aitken, associate director of the Lick Observatory, in a report to the Astronomical Society of the Pacific, "it is still impossible to predict with perfect accuracy the central line of the shadow path at any eclipse. The outstanding error is only a small fraction of a mile, and when the eclipse lasts one or more minutes this is quite unimportant, since the eclipse path is then many miles wide. On April 28, 1930, however, this small uncertainty is serious, and, for all his care, the astronomer may find himself just too far north or too far south to be on the shadow path.

"That is the reason why astronomers at the coming eclipse are planning chiefly to make spectrographic observations of the sun's lower atmospheric layers, known as the chromosphere; for these can be carried out successfully and with results of decided value, even if the spectrograph is just outside the shadow path.

"A photograph of the corona, however, can be taken only at stations on the path. The Lick Observatory-Crocker Expedition, therefore, plans to set up three cameras, one on the computed central line, one about one third of a mile north of it, and a third an equal distance to the south."

In order to predict the most accurate position possible of the path of the shadow, astronomers at the U. S. Nautical Almanac Office, in Washington, under the direction of Professor James Robertson, have made a last-minute calculation of the path. Using observations of the moon made as recently as March 12, they have calculated the path to within a hundredth of a minute of latitude and longitude, or less than a hundred feet. With such recent observations, there should be little wandering of the moon between the last one and the eclipse itself.

HEMIANTHROPUS OSBORNI

FRAGMENTS of skull, face-bones, jaw and shoulder-blade, found by Professor Wilhelm Freudenberg in Ice-Age gravels of the Bammental near Heidelberg, have proved upon piecing together to be the remains of a big ape-like creature with a brain bigger than that of any known anthropoid ape, either living or extinct, says *Natural History*, a publication of the American Museum of Natural History, New York. The animal has been named by its discoverer *Hemianthropus osborni*, in honor of the seventieth birthday of Dr. Henry Fairfield Osborn, president of the American Museum.

The *Hemianthropus* part of the name is Greek for "half-man." The creature, if an ape, was a highly ad-

vanced kind of an ape. Its somewhat gorilline face was uncommonly wide, and its brain is stated to surpass that of the Trinil skull from Java, and to equal in size the brain of Neanderthal man. The Trinil skull, *Pithecanthropus*, is considered to be human by a great many scientists, though some are of the opinion that it belonged to an ape; but Neanderthal man is unquestionably human. The editor of *Natural History* adds a note that "the question of the validity of *Hemianthropus osborni* as distinct from Heidelberg man remains an open question."

The Heidelberg man has been represented to date only by a jawbone found at Mauer near Heidelberg, in sands of the same geologic age as the gravels that have yielded the bones of *Hemianthropus*. It has been regarded as undoubtedly human, though of a very primitive type, characterized chiefly by its exceedingly massive structure and its almost total lack of a chin. The jaw which Professor Freudenberg found is even more chinless than the classic Mauer specimen. Its lower border resembles that of the Java skull.

Professor Freudenberg has been a tireless searcher for human and anthropoid remains in the region around Heidelberg. Recently he found a portion of a broken and water-worn arm-bone which he attributes to a fossil gibbon.

MID-ATLANTIC ISLETS AND GEOLOGICAL THEORIES

FOUR tiny islets in the middle of the Atlantic Ocean, the largest of them only an eighth of a mile across, bear heavy evidence against the validity of the Wegener hypothesis of the westward drift of the American continents, which has proved very attractive to many geologists. Dr. Henry S. Washington, of the Carnegie Institution, discusses the significance of these rocks, and especially their bearing on the problem of the origin of the long submarine ridge of which they are a part, in the first issue of the *Journal* of the Maryland Academy of Sciences.

The islets are known as St. Paul's Rocks, and they stand up alone in the midst of the South Atlantic, almost midway on the shortest line that can be drawn between Africa and South America. But although the highest point on them is only 64 feet above high-tide mark, the islands are lofty mountain-tops. For they are a part of a 9,000-mile-long submarine mountain range, or ridge on the ocean bottom, that extends through the middle of the Atlantic Ocean throughout almost its entire length, and rises in places as much as 18,000 or 20,000 feet above the bottoms of adjacent deeps. Other peaks that raise their heads above the surface of the sea form the islands and island groups of the Azores, Ascension, Tristan da Cunha, St. Helena, Gough and Bouvet. Of these, all except St. Helena lie directly on top of the ridge.

The course of the ridge is most peculiar and suggestive. It holds very closely to mid-Atlantic throughout, running almost directly north and south in the South Atlantic, swinging northwesterly to parallel the coasts of South America and western Africa, then north and northeasterly in the North Atlantic. In general, it runs parallel with the continental land lines through its whole length.

Geologists have long puzzled over why this ridge should exist and why it should follow the course it does. Two completely opposite theories have been advanced: one, that it represents the edge of a rift in the earth's crust caused by the pulling apart of the eastern and western continents; the other, that it is due to the squeezing together of the crust under the ocean basin, causing it to hump up.

The rocks of the little mid-oceanic islets furnish the clue. All the other islands located on the ridge are volcanic, and their lavas tell little, because they are melted rock, coming from unknown depths and resulting from imperfectly known physical and chemical processes. But the stone that forms St. Paul's Rocks is not a lava, but part of the deep crust of the earth, like the granite of our older mountains on land, though even more massive and heavy, and different in its chemical composition. The group of St. Paul's Rocks is the only place on the whole course of the ridge where the real crustal stuff from under the ocean bottom comes to the surface.

Dr. Washington finds that this massive rock shows signs of having been subjected to tremendous squeezing pressures, such as could have come only from sidewise thrusts humping up the ridge between them, and not from a tensional effect resulting from the pulling apart of the continents.

A NEW PHOTOELECTRIC CELL

RUNNING motors with electricity from sunlight is one of the possibilities forecast by the invention of a new type of cell that converts light directly into useful quantities of current. It is the invention of Dr. B. Lange, of the Kaiser Wilhelm Institute for Silicate Investigation. Previously this has not been possible. The new cell, the essential part of which is a "sandwich" of copper oxide between two layers of metallic copper, may also prove a revolutionary improvement in talking movies and television and in many phases of scientific work.

Ordinary photoelectric cells, consisting of a layer of a metal such as potassium inside a glass bulb containing either a vacuum or a small amount of inert gas, can only be operated with an auxiliary source of electric current. When light falls on the potassium layer, electrons are given off. When connected to a battery, or other source of current, the electrons are carried to another metal plate or wire which forms the other electrode. Thus, the flow of the current is regulated by the amount of light falling on the potassium layer.

In Dr. Lange's cell, the light falls on one of the thin copper layers and the electrons are driven off. They pass through the copper oxide layer, which is exceedingly thin, only a few layers of molecules in depth. When they reach the other layer of copper an electric current results. Because of the short distance through which the electrons have to travel, the cell operates without the slightest appreciable lag. The current given off is

powerful enough that when a rapidly flickering light shines on the cell, the current can be fed into a loud-speaker and a note vibrating at the same rate as the light can be heard.

Other advantages of the copper cell are that it does not show fatigue as does the ordinary type, it can be operated indefinitely without loss of efficiency and it is much more sensitive to the infra-red waves, too long to be visible.

In round numbers, Dr. Lange estimates, his new cell is ten times as efficient as the older types. But by the proper adjustment of the middle layer, and the use, perhaps, of other materials than copper oxide, he foresees the possibility of increasing the efficiency still further and converting light directly into large quantities of electricity. Even as constructed at present, the cell should prove a radical improvement in talking movies and television. It will also, suggests Dr. Lange, be useful as a photometer, to measure light intensity, because the current given off is directly proportional to the light falling on it, over a long range of brightness.

ITEMS

THE vital hormone of the cortex of the adrenal gland has been obtained in an extract called cortin, Professor F. A. Hartman and Dr. K. A. Brownell, of the University of Buffalo, reported to the American Physiological Society. The adrenal gland has two parts, one of which, the cortex, is essential to life. When the adrenal cortex is destroyed by disease or accident or removed by operation, the animal or man dies shortly. However, the Buffalo scientists stated that their extract will prolong the lives of animals whose adrenal glands have been removed so that they live from two and one half to three times as long as untreated animals without adrenals. The extract when properly made is harmless when injected into human beings. It has been given by mouth with beneficial results in some instances. The method of preparing it was briefly described in the report.

NEW knowledge of the vitamins was disclosed at the Chicago meeting of the American Society of Biological Chemists. Destruction of vitamin A by radiothorium was reported by Professor A. G. Hogan, C. L. Shrewsbury and Gerald F. Breckenridge, of the University of Missouri. This vitamin is important for promoting growth and for preventing eye disease. It is found in butter, cheese, eggs, spinach and liver. While the experiment was conducted with radiothorium, the inference is that any radioactive substance would have the same effect on this important vitamin.

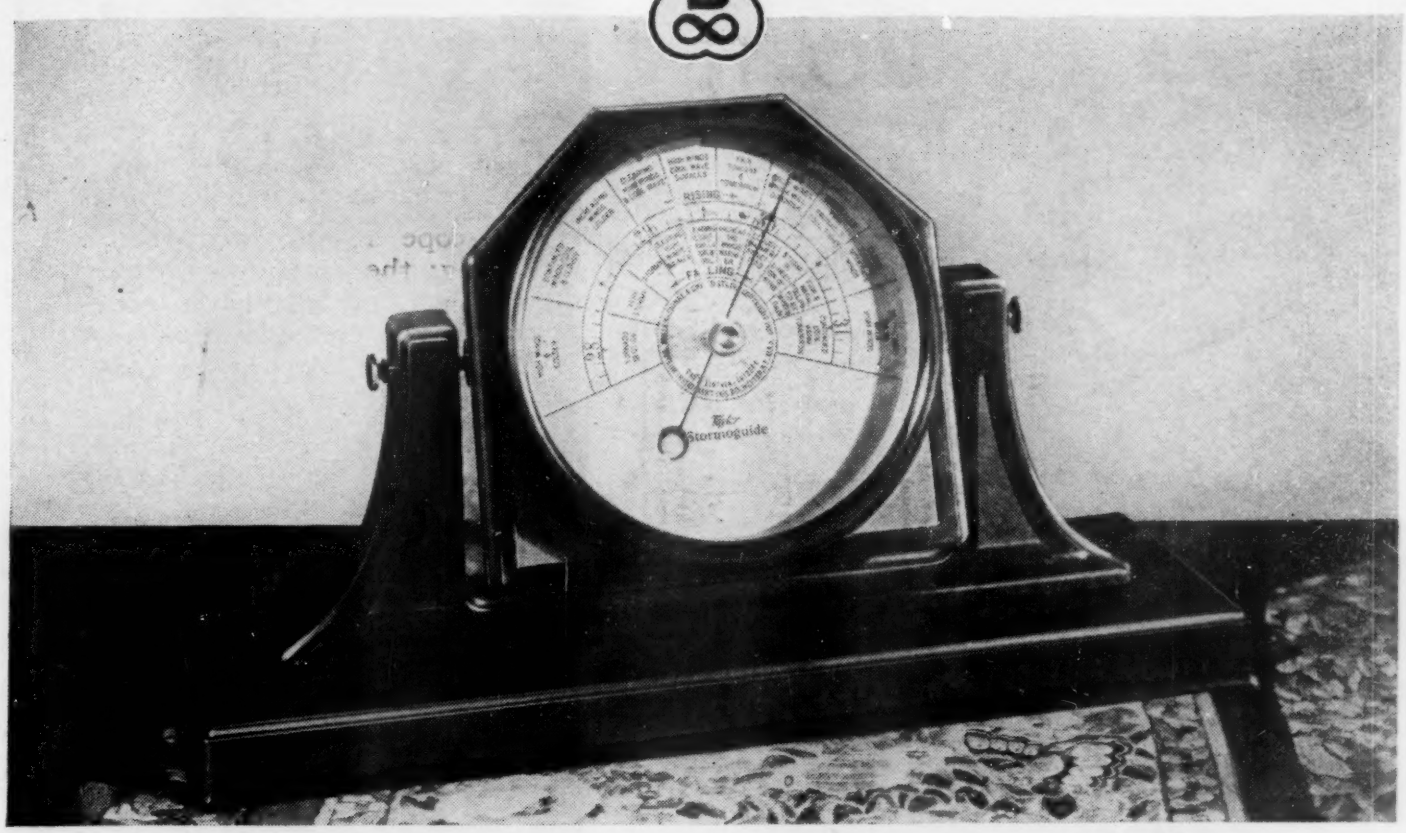
EVIDENCE that the California condor, largest of flying birds, once ranged well to the east of its present habitat in California has been discovered in Conkling Cavern, N. M., the celebrated bone cave where human remains were recently discovered associated with fossils of extinct camel, ground sloth and other strange animals. One wing bone has been identified as that of a California condor by Dr. Hildegarde Howard, of the Los Angeles Museum, whither the bones from the cavern have been removed. In all, the cave has yielded about 100 bones of birds.

THE world's smallest opossum, a tiny animal no bigger than a mouse, is a native of Argentina. H. Harold Shamel, of the U. S. National Museum, who describes the new species in the *Journal* of the Washington Academy of Sciences, states that the specimen was collected some time ago by Dr. Alexander Wetmore, but that it remained unstudied in the museum until now. The little opossum is less than five inches from nosetip to tailtip, and nearly half its length is accounted for by tail. The specific name given it is *muscula*, which means "little mouse." There are many species of mouse which are larger.

CANADA would like to stop buying $3,000,000 worth of sulfur in the United States every year. An experimental plant for extracting sulfur from the mineral, iron pyrite, has begun operation in the hope of producing sulfur at a cheaper price than the import cost, Horace Freeman, chemical engineer, of Shawinigan, Que., told the Canadian Institute of Mining and Metallurgy meeting at Toronto. Canada must have sulfur to make the sulfite liquor used in her vast paper industries and to make sulfuric acid. Most of America's sulfur is now mined in Louisiana and Texas in a practically pure state. Combined with iron, as the sulfide or pyrite, it is found in large quantities very near Canadian paper mills, but in the past there has been no satisfactory method of extracting it.

EVEN if Americans are wasteful, as is often claimed, they salvage nearly a billion dollars' worth of their waste every year. This is according to figures of the U. S. Bureau of Mines on the amount of scrap and secondary metal recovered which is increasing every year. The waste trade industry is concentrating in large units. Even gold and silver is recovered in quantity from jewelry and dental waste. Photographic solutions contain half an ounce of silver to the gallon and 1,000,000 feet of waste movie film yield 800 ounces. Of the 500,000 tons of secondary copper recovered annually, part comes from 300,000 burned out electric lamps collected by one company. About forty per cent. of the annual supply of tin and lead has been used before. The iron and steel saved in a year is worth $500,000,000. Other metals salvaged in quantity from scrap, sweepings, skimmings and dross are mercury, zinc, antimony, aluminum and nickel.

HELIUM has been produced at the government plant at Amarillo, Texas, at a cost which compares favorably with that of hydrogen. More than a million cubic feet of the non-inflammable airship gas, of which the United States has a monopoly, was made during January for a net cost to the government of $9.64 the thousand cubic feet, according to a statement made by the U. S. Bureau of Mines, which built and operates the plant. Inflammable hydrogen, which is still used in lighter-than-air craft of other nations, can be made at costs varying from three to nine dollars the thousand cubic feet.



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